A CLASSIFICATION OF GEOGRAPHIC ELEMENTS AND ANALYSIS OF THE FLORA OF BIG BEND REGION OF TEXAS

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ABSTRACT

The flora of the Big Bend region in the Trans-Pecos Vegetational Area of SW Texas was studied from a biogeographical perspective. A checklist of the designated flora was extracted primarily from the *Synthesis of the North American Flora* and data concerning the general distribution of species were obtained from the literature, the "*Synthesis*," and other on-line databases. There are 1587 native species in 592 genera and 125 families in the flora. These species, based on their contemporary distribution outlines, were classified into 19 geographic (floristic) elements. The genera were classified into 19 geographic groups based on their general distribution. Herein is presented a classification scheme of geographic elements (geoelements), the checklist accompanied by the geoelement descriptions, and the analysis of the flora. The Big Bend region flora—being on the boundary of two subkingdoms, the Madrean and Boreal—has a complex pattern of connections, with predominance of the autochthonous xerophytic taxa evolved from the Madro-Tertiary geoflora stalk. Laurasin (Arcto-Tertiary) flora derivatives play a lesser role. The strongest connections of the flora are with Mesoamerica-South America. The Madrean species (66%) and especially the Chihuahuan endemics (26%) are most numerous. In the generic composition, south-western and western North American, followed by tropic/subtropical, genera are much better represented than north and eastern American temperate genera. Eastern and western Northern Hemisphere's connections across the Atlantic, show three different patterns: northern early Tertiary migrations of the Laurasian mesophyllous genera, diversification of older Madro-Tethyan subtropical genera along the Tethys seaway, and migration westward along the southern Tethys shore of termophyllous ancient taxa originated or preserved in the Horn of Africa region.

RESUMEN

La flora de la región de Big Bend en el área de vegetación de Trans-Pecos en el de SW Texas se estudió desde la perspectiva biogeográfica. Primeramente se extrajo un catálogo de la flora de la *Synthesis of the North American Flora* y se sacaron datos bibliográficos relativos a la distribución general de las especies, la "*Synthesis*," y otras bases de datos on-line. Hay 1587 especies nativas en 592 géneros y 125 familias en la flora. Estas especies, según sus perfiles de distribución contemporánea, se clasificaron en 19 elementos geográficos (florísticos). Los géneros se clasificaron en 19 grupos geográficos según su distribución general. Aquí se presenta un esquema de clasificación de elementos geográficos (geoelementos), el catálogo acompañado por las descripciones de los geoelementos, y el análisis de la flora. La flora de la region Big Bend—en la frontera de dos subreinos, el Madreano y el Boreal—tiene un patrón complejo de conexiones, con predominio de taxa xerofíticos autóctonos evolucionados del núcleo florístico Madro-Terciario. Las derivaciones de la flora Laurasina (Arcto-Terciaria) tienen un papel menor. Las conexiones más fuertes de la flora son con Mesoamérica-Sur América. Las especies Madreanas (66%) y especialmente los endemismos Chihuahuanos (26%) son los más numerosos. En la composición genérica, los géneros del suroeste y oeste norteamericano, seguidos por los tropicales/subtropicales, están mucho mejor representados que los templados del norte y este americano. Las conexiones este-oeste del hemisferio norte a través del Atlántico, muestran tres patrones diferentes: migraciones al norte en el Terciario temprano de géneros Laurasianos mesófilos, diversificación de los géneros subtropicales más viejos Madro-Tetianos a lo largo de de la ruta del Tetis, y migración hacia el oeste a lo largo de la costa sur del Tetis de los taxa viejos termófilos originados o preservados en la región del cuerno de in África.

INTRODUCTION

The Trans-Pecos region of Texas or West Texas Vegetational Area (Correll & Johnston 1970) is distinct from that of surrounding areas in Texas because of its numerous mountain systems and low arid basins with elevation ranges from 305 to 2388 m (1000–7835 ft) (Powell 1998). It lies on the northern edge of the Chihuahuan Subprovince of the Sonoran Province of Takhtajan's floristic system (Takhtajan 1986) and thus on the boundary of two Subkingdoms of the Holarctic Kingdom: the Boreal and Madrean. An analysis of such flora can provide a good opportunity to reveal proportions of different floristic elements, to look for Arcto-Tertiary and Madro-Tertiary (Axelrod 1958; Raven & Axelrod 1987) relicts, and to specify the

level and areas of endemism (Platnick 1991; Morrone & Crisci 1995). Northern and eastern limits of the Madrean region are difficult to delineate and they were subject of debate in the North American literature (Good 1974; Cronquist 1982; Morrone et al. 1999; McLaughlin 2007; see McLaughlin 2007:31 for comparison; also Katinas et al. 2004; and Fenstermacher et al. 2008). The Northern Madrean boundary is a composite area were different distribution tracks overlap and partial floras of different types of vegetation in the mountains represent historical elements of different origins, affinities, and age, both relictual and progressive, autochthonous, and migrational.

The flora of three counties in the Big Bend region—Brewster, Presidio, and Jeff Davis—was chosen to test the floristics in the Chihuahuan Subprovince. A major objective is to reveal the taxonomic proportions and biogeographic affinities of the plant taxa in the region.

MATERIALS AND METHODS

Using primarily the *Synthesis of the North American Flora* (Kartesz & Meacham 2002; Kartesz 2008), a checklist of the flora of Brewster, Presidio, and Jeff Davis counties in Trans-Pecos was compiled. The non-native species were excluded. Several new species were added to the checklist draft after it was compared with the one of the Dead Horse Mountains, Big Bend National Park (Fenstermacher et al. 2008). Taxonomic counts of the families, genera, and species were performed. The distributional and other data were obtained from the Synthesis of the North American Flora (Kartesz & Meacham 2002), Tropicos (Tropicos.org.), Flora of North America, Digital Flora of Texas databases, the Onagraceae website (Wagner & Hoch 2005), the literature (Correll & Johnston 1970; Powell 1998; Turner et al. 2003; Diggs et al. 1999; Villarreal 2001), and other sources. The distribution outlines of all the species in the flora were studied. Congruent distributions of two or more species were named after well known chorionomic units (Takhtajan 1986; Thorne 1993; Rzedowski 1978) or in geographic terms. Each species was thus referred to and treated as a particular geographic element, or geoelement (Saghatelyan 1997a, b) of the flora. All the species were classified into 19 geoelements according to their general distributional patterns revealed during the current study. The distribution data on the genera were retrieved from Wielgorskaya (1995) and Mabberley (1997). The genera were classified into 19 groups based on their distribution outlines.

The species list (Appendix 1) for the above-mentioned counties was prepared with the major objective of defining the geoelements individually and collectively represented. Proportions of geoelements in a flora are robust characteristics which are not sensitive to minor nomenclatural changes. "Good species" always have "good ranges" and they usually serve as a basis of biogeographic analysis. The ranges of some species could not be referred to a particular geoelement; they are noted with a question mark in the checklist and are omitted from the analysis. Major outcomes expected from the analysis are:

1. Proportion of the species and genera of the Boreal and Madrean Subkingdoms and their provinces and subprovinces in the flora.
2. Northern temperate versus southern subtropic & tropical connections of the flora.
3. Proportion of the species confined to one, two, or more subprovinces of the Sonoran Province.
4. The weight of the northern Madrean species in the Madrean element of the flora.
5. Connections of the Madrean and Tethyan subkingdoms.
6. Major migrational tracks.

RESULTS

A CLASSIFICATION SYSTEM OF GEOGRAPHIC ELEMENTS AND THEIR PROPORTIONS IN THE BIG BEND REGION FLORA (TABLE 1)

Abbreviations: **C**–center; **TX**–Texas; **CA**–California; **CO**–Colorado; **AZ**–Arizona; **OK**–Oklahoma; **MO**–Missouri; **WO**–Wyoming; **SMO**–Sierra Madre Oriental; **Rocky M**–Rocky Mountains Province; **Mont**–montane; **US**–United States; **Mesoam**–Mesoamerican; **Gulf Coast**–Atlantic and Gulf Coastal Plain Province; **Tr–Pecos**–Trans-Pecos; **J Davis**–Jeff Davis; **c**–county; **cc**–counties; **Warm**–warm temperate.

Table 1. Proportions of geographic elements in the Big Bend flora.

Geoelement	Subelement	Number of species
Madrean		192
Sonoran-Chihuahuan		80
Sonoran		82
Chihuahuan		253
Chihuahuan-Tamaulipan		50
SW North American		149
	S Rocky Mountain-Madrean	20
	SWC US & SWC N American	64
	Apachian/SW US & SW N American	65
W US/W N American		133
	WUS/W N American	76
	WC US/WC N American	29
	S Great Basin-Sonoran/Chihuahuan	9
	Amphitropical	19
S TX Endemic		101
Prairie		88
EN American		37
Comanchian/SC US		45
N American		98
Mesoamerican		84
American		101
	American wide	96
	Western American	5
Tropical/Subtropical		32
	American-African	6
	Tropical/Subtropical	26
Holarctical		21
Polichorous		14
Not established		25
Total		1587

1. **Polichorous:** wide distribution on several continents. There are 14 species (sp.) of herbaceous wetland (*Veronica peregrina*), aquatic (*Potamogeton nodosus*), and weedy (*Plantago major*) plants of this geoelement in the flora.
2. **Holarctical:** wide ranges in north temperate latitudes of the New and Old World; 21 mesophytic species. Among them are 6 sp. of grasses (*Bromus ciliatus*), 2 sp. of horsetails (*Equisetum hyemale*), and a fern (*Asplenium trichomanes*). Other large north temperate genera have just 1–2 sp. each (*Campanula rotundifolia, Ranunculus sceleratus,* and *Artemisia campestris*) in the flora.
3. **Trop/Subtr:** wide distribution in tropical and subtropical latitudes; 32 species. Mesophytic, aquatic and wetland species, especially of herbaceous habit (*Thypha domingensis, Bacopa monieri*) predominate in this group. There are also several shrubs (*Sapindus saponaria, Parkinsonia aculeata,* and *Acacia farnesiana*) of pantropical or subtropical distribution. Two sub-elements of Trop/Subtr element are listed below.
   - **3a. American-African:** the previous type restricted to America and Africa. Seven species: three of grasses (*Echinochloa crus-pavonis*), three of sedges (*Cyperus squarrosus*), and one fern (*Cheilanthes bonariensis*).
   - **3b. Warm Temperate/Subtropical:** mostly in subtropical and warm temperate regions. Only 11 sp. of grasses (*Digitaria sanguinalis*) are in this group.
4. **American:** wide distribution in the Americas; 101 sp. Here are mostly subtropical weedy grasses (29 sp.: *Bouteloa barbata*) and sedges (8 sp.: *Cyperus seslerioides*), as well as temperate Asteraceae (6 sp.: *Conyza*

canadensis). Western American (Cordilleran) genera have six species (*Muhlenbergia rigida, Epilobiium ciliatum*), while 5 species of *Amaranthus* and *Heliotropium* are mostly Caribbean.

4a. American Trop/Subtr: widely distributed in tropical and subtropical (warm temperate) parts of the Americas. This sub-element has 30 of the 101 sp. of the American element with the grasses (*Cenchrus myosuroides*) being especially numerous. Other examples are *Tillandsia recurvata, Solanum elaeagnifolium, Phyla nodiflora,* and *Ipomoea cardiophylla*.

5. North American: more or less wide ranges in temperate regions of North America; 98 mesophytic species. They either belong to widely north temperate genera (*Maianthemum racemosum*, *Carex hystericina,* and *Vicia americana*), north American genera (*Solidago gigantea, Lobelia cardinalis, Monarda fistulosa*), or cosmopolitan genera with large sections in temperate latitudes (*Euphorbia cyatophora*). Herbaceous habit, especially in the grasses (18 sp.), sedges (8 sp.), Asteraceae, and Euphorbiaceae (6 sp. each) predominate. A few older montane woody species have interesting ranges: either absent in the south-eastern and south-central region (*Prunus virginiana*), poorly represented in the western and absent in the central (*Cephalanthus occidentalis*) region, or those that tend to the Rocky Mountain (*Cheilanthes feei)* Region.

6. East North American: wide ranges in the Atlantic North American Region of Cronquist (1982). Representatives of ancient Laurasian genera are essential among the 37 sp. of this geoelement (*Ostrya virginiana, Carya ilinoensis,* and *Clematis pitcheri*). A few species however have tropical connections (*Cocculus carolinus*, *Celastrus scandex*, and *Nothoscordum bivalve*).

6a. Gulf Coast-(Caribbean): with ranges in the namesake provinces (*Thelipteris ovata, Melothria pendula*).

6b. Appalachian: with ranges in the namesake province (*Ostrya virginiana, Melica nitens*).

7. Comanchian/ SC US: Edwards Plateau westward to the Trans-Pecos extending northward into central Oklahoma or further to Ozark Plateau, southward into northeastern Mexico and western Lousiana, mainly in the limits of the Comanchian Subprovince of McLaughlin (2007). There are 46 species in this geoelement like *Juniperus ashei, Lupinus texensis,* and *Scutellaria wrightii*, with some having disjunct relictual ranges (*Leptopus phyllanthoides*).

8. Prairie: wide ranges in the North American Prairies Province of Cronquist (1982); 85 mostly herbaceous species. Biggest group of 24 sp. is in Asteraceae (*Liatris punctata, Hymenopappus scabiosaceous*), especially in the Heliantheae s.l. (Panero & Funk 2002). Poaceae (*Bouteloua dactyloides, Schedonnardus paniculatus*), and papilionaceous Fabaceae (*Astragalus lotiflorus, Dalea aurea*) have 7 sp. each. Remaining species are in large temperate genera (*Oenothera triloba*, *Salvia azurea*) with big centers of diversity in western America and Mexico.

8a. S Prairie/SC North American: from Central and South Texas extending northward to adjacent states and southward to northern Mexican Plateau (*Eryngium leavenworthii, Argythamnia humilis, Rhus lanceolata,* and *Gaillardia suavis*).

9. W North American: wide ranges in the entire western North America or its parts mostly north of Mexico. Among the 133 sp. of this geoelement 28 sp. of Asteraceae (*Brickelia californica, Erigeron divergens*) prevail, followed by 18 sp. of Poaceae (*Agrostis exarata*) and 9 sp. of Brassicaceae (*Stanleya pinnata*). Western American genera have numerous species (*Glossopetalon spinescens*, *Cryptantha cinerea*) including the dominants in different types of communities. Examples range from those of montane forests (*Pinus ponderosa*, *Quercus gambelii*, and *Cercocarpus montanus*), Rocky Mountain and Madrean woodlands and shrublands (*Juniperus scopulorum*, *Rhus trilobata, Holodiscus dumosus*), to widely distributed xerophytic (*Opuntia polyacantha*) as well as riparian (*Salix exigua*) species.

9a. WC US/ WC North American: includes western mountainous (not Pacific) region and western half of the Prairies Province in the United States/or southward to central Mexico; this element supports S. McLaughlin's (2007) Western Region. Of the 133 sp. of W North American element, 29 sp. are in this sub-element. They belong to large temperate genera (*Astragalus, Cirsium,* and *Lithospermum*), North American genera (*Monarda pectinata, Oenothera albicaulis*), or a few tropical (*Heliotropium convolvulaceum*) genera.

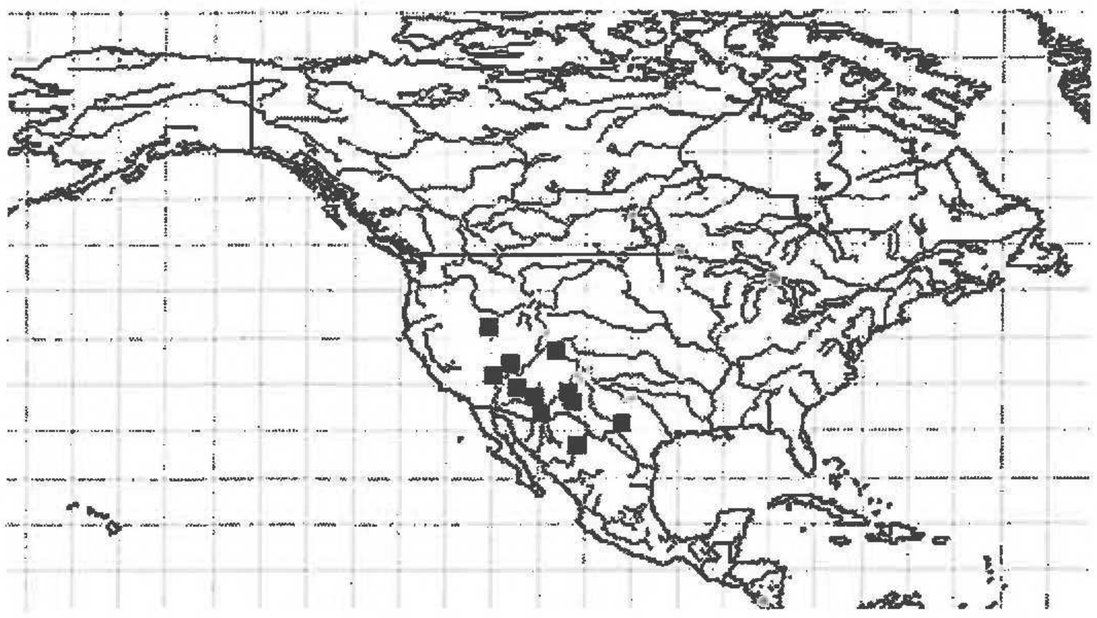

Fig. 1. Distribution of *Yucca baccata*. SW N American element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

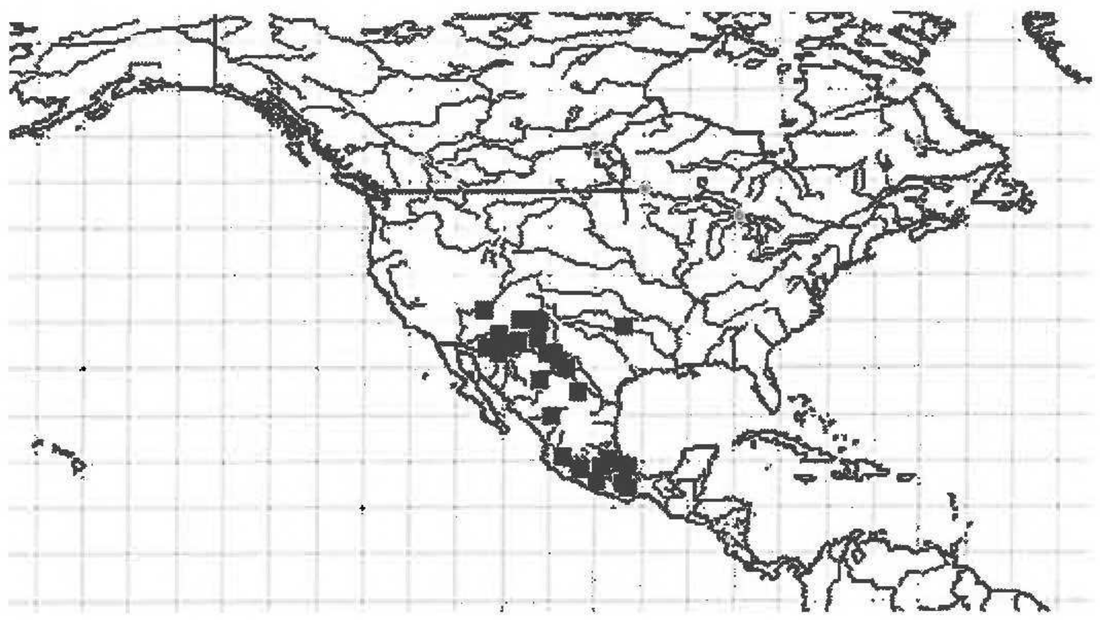

Fig. 2. Distribution of *Juniperus deppeana*. Madrean element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

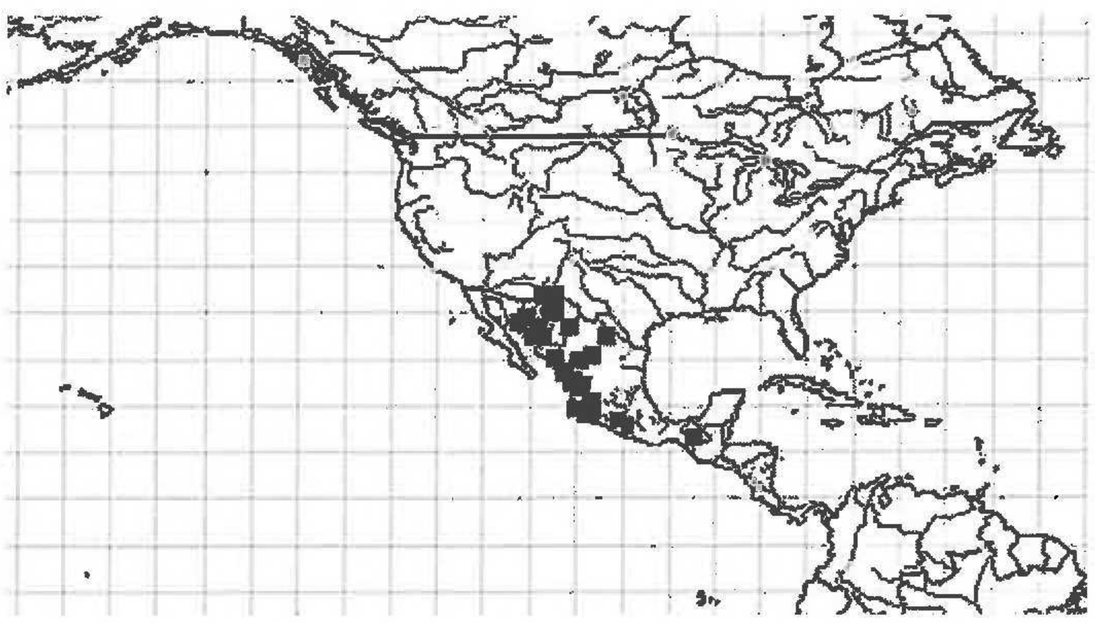

Fig. 3. Distribution of *Kallstroemia grandiflora*. Madrean (W) element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

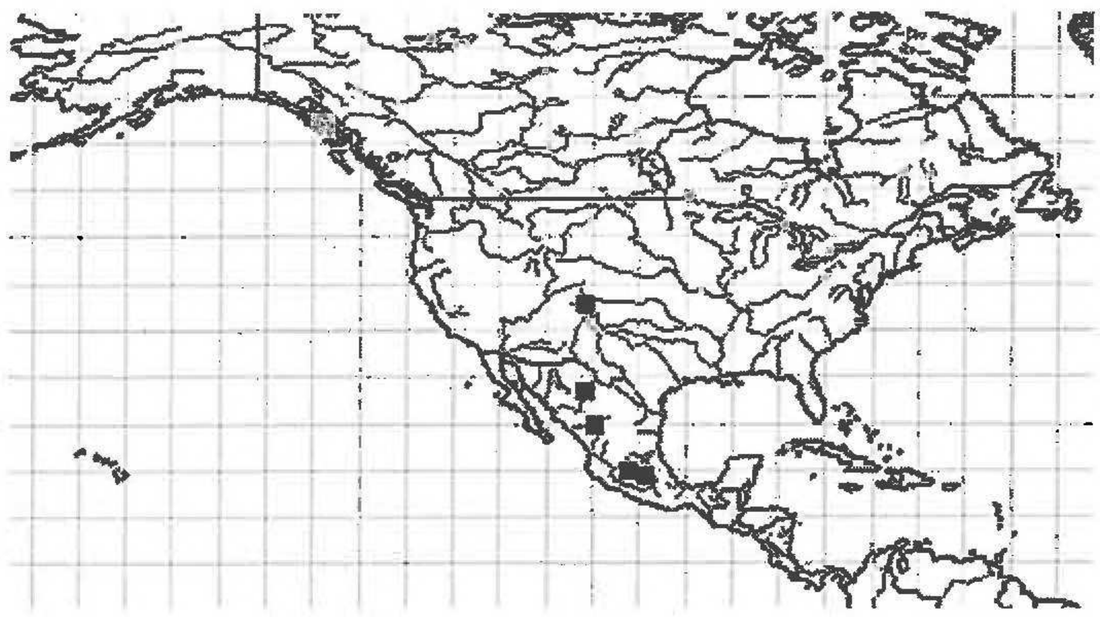

Fig 4. Distribution of *Cleome multicaulis*. South Rocky Mountain-Madrean element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

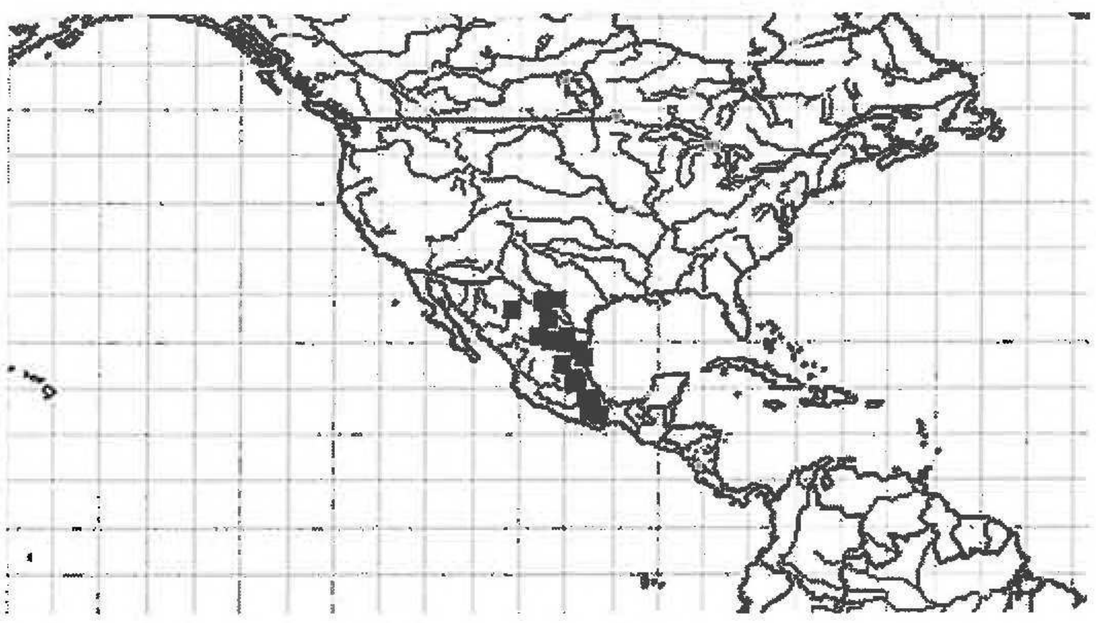

Fig. 5. Distribution of *Rhus virens*. E Madrean element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

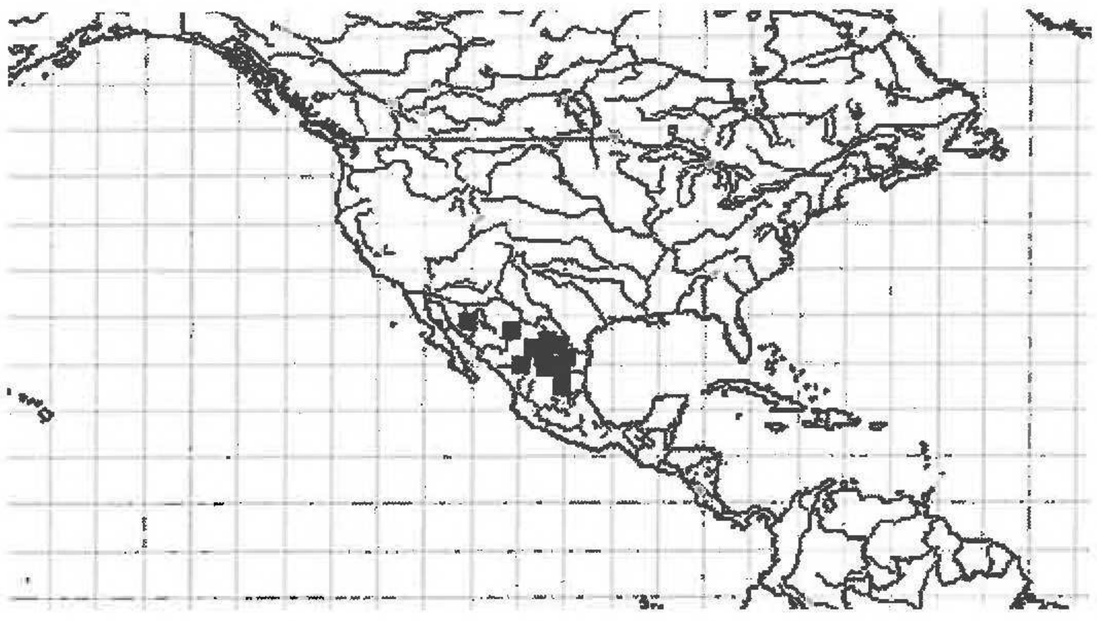

Fig. 6. Distribution of *Peganum mexicanum*. Sonoran-Chihuahuan element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

10. SWC North American/ SWC US: more southern/eastern than the previous geoelement: from Colorado Plateau, southern Rocky Mountains and south-western part of the Prairies Province southward to the US border or Sierra Madre Occidental/more eastern central Mexico. Among 64 species of this element those of western and south-western North American genera predominate. The grasses (11 sp.), Asteraceae (9 sp.), and Fabaceae (5 sp.) are followed by species of typical American desert genera in Agavaceae (*Nolina texana*), Hydrophyllaceae, Onagraceae, Cactaceae, etc. Several species of this element are of woody habit (*Quercus mohriana, Lonicera albiflora*).

11. SW North American/ SW US: southern part of the Rocky Mountain Province, Colorado Plateau, southern and eastern Great Basin, southeastern California (not always), both Mohavean and northern Sonoran Subprovinces of the Cronquist's (1982) system eastward through New Mexico to southwestern Texas and southward to adjacent northern Mexico. A group of 65 xerophytic species including 5 out 7 species of Hydrangeaceae of the Big Bend flora, *Ephedra torreana, Yucca baccata* (Fig. 1), *Opuntia phaeacantha* and other desert dominants. All herbaceous species are those of desert genera (*Mentzelia multiflora, Hackelia pinetorum,* 9 sp. each of Poaceae and Asteraceae, etc.). There are two subtypes:

11a. Apachian: from central to southeastern Arizona, western New Mexico, to northeastern Sonora, and northwestern Chihuahua as delineated by McLaughlin (2007). Among species of the southwestern element 20 sp. are in this sub-element (*Penstemon jamesii, Boerhavia torreyana,* and *Phlox nana*).

11b. S Great Basin-Sonoran-Chihuahuan: ranges from the southern half of the Great Basin Province southward into Sonoran and Chihuahuan Subprovinces of Cronquist (1982). Nine species are restricted to this area, mostly those of south-western genera (*Pennellia longiflora, Abronia angustifolia*).

12. Amphitropical: disjunctive ranges in warm temperate deserts of the western North and South America; 20 species. Among them are 6 sp. of grasses, 3 sp. each of Fabaceae and Asteraceae and one in each of other desert genera (*Aloysia gratissima, Kallstroemia parviflora,* and *Mentzelia albescens*.)

13. Madrean wide: ranges embracing Takhtajan's (1987) Madrean Region in some cases excluding the California Province (Figs. 2, 3). Most spectacular group of 192 species with the highest number of woody species-dominants in various types of mountain and desert communities. The prevailing families are: Asteraceae (30 sp.), Poaceae (24 sp.), Fabaceae (15 sp.), Euphorbiaceae (15 sp.), and Pteridaceae (11 sp.). Very important are 4 sp. each of Cupressaceae, Rhamnaceae and Oleaceae, 3 sp. of Zygophyllaceae, including *Larrea tridentata,* 2 species of *Ephedra, Juglans major, Garrya ovata, Rhus virens* and *Morus microphylla*. About 30 species of the flora with wide Madrean distribution are absent in California and most of the Great Basin Provinces. The madrean element has following subelements.

13a. S Rocky Mountain-Madrean: along the Rocky Mountains from Colorado Plateau southward to Sierra Madre Occidental Province or further into the Madrean mountains (Fig. 4). There are 20 species in this sub-element mostly of Asteraceae (5 sp.), Brassicaceae (3 sp.), and Malvaceae (3 sp.). The species of western American genera (*Castilleja integra*) predominate, however a few species are of tropical/warm temperate genera (*Cleome multicaulis*).

13b. East Madrean: mostly in the Sierra Madre Oriental Province of Morrone et al. (1999) extending northward to the Edwards Plateau and mountains in Trans-Pecos (Brewster, Jeff Davis, and Presidio counties). The following species highlight this sub-element: *Rhus virens* (Fig. 5), *Fraxinus cuspidata, F. greggii, Croton incanus, Euphorbia bifurcata, Dalea gerggii, D. frutescens, Centaurium calycosum, Oenothera calcicola, O. primiveris,* and 6 sp. of Pteridaceae.

13c. North Madrean: ranges in northern, mostly US part of the Madrean Region of Takhtajan (1987), southward to Mexican part of the Sonoran Subprovince and south-western Texas. This subelement has 57 sp. of the madrean element in the genera with following ranges: south-western North American (*Wislizenia refracta*), central-to tropical American (*Matelea parviflora*), mostly N American (*Symphoricarpos palmerii*), western N and S American (*Hedeoma nana*), and tropical/subtropical American (*Proboscidea parviflora, Boerhavia wrightii*). Several species are in cosmopolitan (*Chamaesyce*, 5 sp.) and north temperate (*Eriogonum,* 3 sp., *Galium*) genera.

14. Mesoamerican: wide ranges in Mesoamerica and Caribbean Region extending to southern United States and northern South America; 83 species. Most of them are among the Asteraceae (17 sp.), grasses (9 sp.), legumes (8 sp.), and ferns (5 sp.). The species of Mesoamerican-Madrean (*Bouvardia ternifolia*), Mesoamerican-S American (*Margaranthus solanaceus*), tropical (*Cyclanthera dissecta*) and subtropical American (*Macroptilium gibbosifolium*), as well as widely American (*Oenothera hexandra*) genera prevail. Two species, *Arbutus xalapensis* and *Helianthemum glomeratum,* are in the Madro-Tethyan genera.

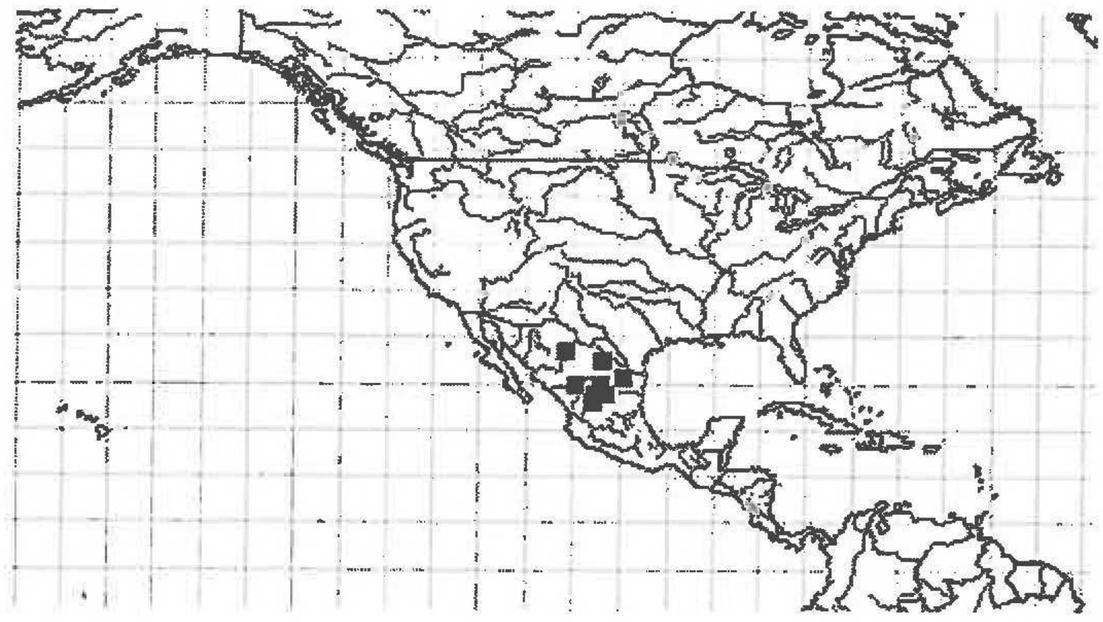

Fig. 7. Distribution of *Condalia ericoides*. Chihuahuan element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

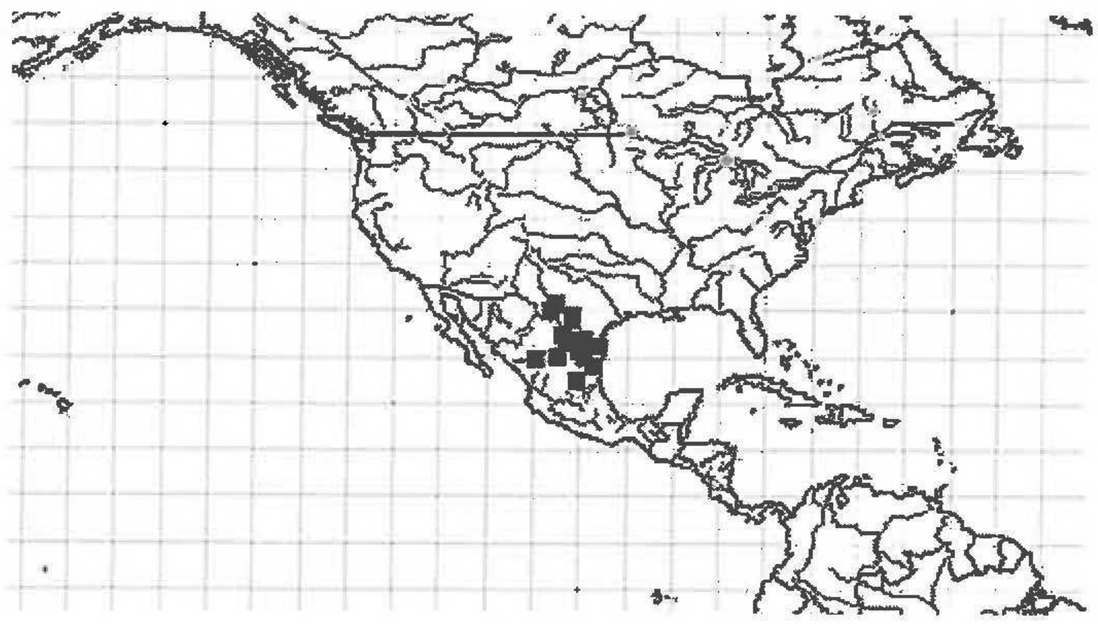

Fig. 8. Distribution of *Leucophyllum frutescence* Chihuahuan-Tamaulipan element. Source: Tropicos.org. Missouri Botanical Garden. 27 Mar 2009 <http://www.tropicos.org>.

14a. Mesoamerican-Madrean: wide ranges in the Madrean Region and Mesoamerica southward to Costa Rica. Of the Mesoamerican element, 19 sp. are in this subelement (*Quercus rugosa, Chamaesyce villifera,* and *Desmodium psilophyllum*).

15. Sonoran wide (or Sonoran Province): embracing all subprovinces of the Sonoran Province of Cronquist (1982); 82 xerophytic species including many dominants of the sonoran desert communities. The legumes (8 sp.: *Calliandra humilis*), Malvaceae, and Nyctaginaceae (6 sp. each) prevail among them. Especially characteristic are those of western American (*Aloysia wrightii, Garrya wrightii*) and SW N American (*Chilopsis linearis*) genera, and some of more widely American genera (*Verbena perennis*). Also very important are four species each of Cactaceae (*Opuntia*) and Rhamnaceae (*Condalia ericoides*), as well as 2 sp. of Rutaceae (*Choysia dumosa*).

16. Sonoran-Chihuahuan: ranges in the Sonoran (+Mohavean) and the Chihuahuan (mostly western part) Subprovinces of the Sonoran Province (Figs. 6, 7). Of the 80 xerophytic species of this element, 18 sp. are in Asteraceae (*Acourtia nana*), while Sonoran wide element has only three species of this family. The 6 sp. of Cactaceae (*Mammillaria grahamii*), 5 each of legumes (*Dalea wrightii*) and ferns (*Cheilanthes villosa*), 4 sp. each of grasses (*Muhlenbergia arenacea*) and *Polygala* are followed by genera with 1–2 species (*Condalia viridis, Peganum mexicanum, Kallstroemia hirsutissima,* and *Salvia henrii*).

17. Chihuahuan: ranges in the Chihuahuan Subprovince including Edwards Plateau (Fig. 8). This richest in the flora geoelement has 253 species which reveals the high level of Chihuahuan endemism and diversification in temperate and tropical-subtropical genera. There are 44 sp. of Asteraceae, 24 sp. of cacti, 18 sp. of legumes, 15 sp. of grasses, 12 sp. each of Boraginaceae (mostly in *Heliotropium* and *Tiquilia*) and Brassicaceae, 8 sp. each of Nyctaginaceae and Lamiaceae, 7 sp. each of Agavaceae, Acanthaceae, and Euphorbiaceae, 6 sp. of Convolvulaceae, 5 sp. each of Fagaceae, Scrophulariaceae and Amaranthaceae, 4 sp. each of Caryophyllaceae, Solanaceae, Polemoniaceae, etc. There are fewer shrubs and small trees (*Ungandia speciosa, Diospyros texana, Leucophyllum minus, Holacantha stewartii,* and *Colubrina texensis*) but they dominate various types of xeric communities. Typical are the rosette forming lilioids (*Dasylirion leiophyllum, Nolina erumpens, Agave* and *Yucca*) and cacti (*Echinocereus, Escobaria*, etc.).

17a. North Chihuahuan: restricted to northern, mostly Unites States portion of the Chihuahuan Subprovince southward to Coahuila, Mexico. There are 35 sp. in this subelement (*Drymaria pachyphylla, Phyllanthus ericoides,* and *Hedeoma plicata*).

18. Chihuahuan-Tamaulipan: ranges in the Chihuahuan Subprovince extending eastward to the Tamaulipan Subprovince. Among 50 sp. of this geoelement 8 sp. are in Asteraceae, however they are of different genera than those of the chihuahuan element. The tropic/subtropical genera in this element are more pronounced (*Forestiera angustifolia, Guajacum angustifolium,* and *Passiflora tenuiloba*).

18b. Tamaulipan-Chihuahuan: ranges in the Tamaulipan Subprovince extending westward to the

Chihuahuan Subprovince. There are 5 sp. in this sub-element (*Agremone sanguinea, Cynanchum barbigerum, Ayenia pilosa, Meximalva filipes,* and *Thelesperma ambiguum*).

19. South Texas-Coahuila: a part of the Chihuahuan element with narrow ranges in SW Texas-(Edwards Plateau), and Coahuila-(Nuevo-Leon) of northern Mexico. This is an interesting group of 103 species (for example, *Lechea mensalis, Andrachne arida, Zanthoxylum parvum*) which deserves a separate analysis. A few subtypes are given below:

19a. South Texas Endemic: mainly in Edwards Plateau extending to Trans-Pecos and along the Rio-Grande valley to N Tamaulipan Subprovince; 8 species (*Lithospermum mirabile, Chamaesyce angusta*).

19b. Trans-Pecos-Coahuila: endemic or subendemic to Trans-Pecos and Coahuila; 29 species (*Quercus carmenensis, Fendlera rigida, Solanum leptosepalum, Eriogonum hemipterum, Phacelia robusta,* and *Selaginella viridissima*).

19c. Trans-Pecos (SW) Texas Endemic: endemic to the Trans-Pecos region or parts of it; 29 species (*Prunus havardii, Eriogonum suffruticosum,* and *Selinocarpus parviflorus*).

19d. Brewster c Endemic: endemic to the Brewster county or only Chisos Mountains; 10 species (*Hectia texensis, Quercus tardifolia,* and *Bouteloua kayi*).

TAXONOMETRIC ANALYSIS OF THE FLORA

1. FAMILIES

There are 1587 species in 592 genera, and 125 families of vascular plants in the Big Bend region flora. Most specious are cosmopolitan families Asteraceae (230 species/107 genera), Poaceae (202/63), and Fabaceae (107/37). They are listed first in the Tethyan (Saghatelyan 2006) floras as well, however, the first two families have as much as 30% of all species of the Big Bend flora. The leading position of Asteraceae reflects their South American origin (Funk et al. 2005) and outstanding diversity in Mexico (Rzedowski 1993; Turner & Nesom 1993; Valdés-Reyna and Cabral-Cordero 1993). The composition of legumes in the Big Bend flora is very different from that in the eastern Tethyan floras as exemplified by the flora Armenia (Saghatelyan 1997a,b; 2006). Unlike absolute dominance of temperate papilionoid legumes in Armenia, the Trans-Pecos flora has all three subfamilies well represented. Armenia has only *Cercis griffitii* of the basally branching Caesalpinioid legumes, the remaining genera being of more derived North Temperate papilionoid Hologalegina (Wojciechowski et al. 2000; Schrire et al. 2005). The Trans-Pecos flora has eastern North American *Cercis canadensis* and 6 genera/17 sp. of other basally branching clades of Caesalpinioideae (Schrire et al. 2005), mostly in Cassieae. Their ranges are in more subtropical latitudes and more eastern parts of the Madrean Region and eastern North America. Six genera and 27 species of the Mimosoideae in Trans-Pecos show only southern connections with the ranges mostly in different, especially the Chihuahuan, parts of the Madrean Region. Prevailing in North temperate floras Papilionoideae (62 sp. in Big Bend) are in the genera with mostly western ranges in North America (*Astragalus, Lupinus, Dalea, Sophora*). Fewer genera have mostly eastern North American ranges (*Lespedeza, Desmodium*), and a few have southeastern (*Rhynchosia, Indigofera*) ranges. According to classification of Schrire et al. (2005), the legume genera of succulent or temperate biome affiliation and amphiatlantic or pantropical disjunction prevail in the Big Bend region flora.

High diversity of the next two families, the American Cactaceae (59/17) and Euphorbiaceae (59/10) is due to the setting in the Sonoran Province, as well as (for Euphorbiaceae) on the southern border of the United States. The middle sized families—Brassicaceae (43/21), Cyperaceae (40/10), Lamiaceae (38/11), Boraginaceae (33/9), Solanaceae (32/10), Pteridaceae (33/8), Nyctaginaceae (32/13) Scrophulariaceae (29/13), Onagraceae (28/4), Malvaceae (24/12), Asclepiadaceae (23/4), Amaranthaceae (22/7), Chenopodiaceae (21/6), Verbenaceae (21/8), and Fagaceae (21/1)—reveal different connections: western and southern more than northern and eastern. The high position of Fagaceae is due to the proximity to the center of diversity of oaks in the highlands of central and eastern Mexico (Nixon 1993). If the Boraginaceae are counted with the western American Hydrophyllaceae (14/2), the combined 47 species would be in fifth place after Cactaceae/

TABLE 2. Major groups of genera of the Big Bend flora.

North Temperte Old World	19
Relictual North Temperte	30
American-African	20
Madro-Tethyan	5
East Gondwanan	5
North American	37
E N American	7
W N American	57
Amphitropical	10
Apachian	5
Chihuahuan	7
Madrean	4
Mega Mexico II	10
Mega Mexico III	26
SW N America	41
Tropic-Subtropical American	56
Tropic-Subtropical	47
Tropic-Warm Temperate	37
Tropical American	21
Tropical	6
Temperate-Subtropical American	7
Temperate-Subtropical North and South	9
Total	466

TABLE 3. Genera combined.

North Temperate (wide and relictual)	54
North Americn Genera (wide and east)	106
Madrean	98
Tropic/Subtropical/(Warm) Genera	212
West/SW/S North American Genera	122
American	288
Laurasian	160
Gondwanan	306

Euphorbiaceae by their importance in the xeric vegetation. The Boraginaceae (Eritricheae) are especially prominent in the California Province (Raven & Axelrod 1978), but also interesting in their geographical connections and tribal representation in the Big Bend. The disjunctive North Temperate Boraginoideae have 12 species of Eritricheae (*Cryptantha*, 9 sp.) and 7 sp. of Lithospermaeae (*Lithospermum*, 5 sp.) in the Big Bend flora. Only slightly fewer species of the Boraginaceae in the flora represent two tropical tribes, the Heliotropoideae (*Heliotropium*, 8 sp.) and Ehretioideae (*Tiquilia*, 5 sp.).

Paucity of species in typical North Temperate families like Caryophyllaceae (15/5), especially the older ones, like Rosaceae (12/9) and Ranunculaceae (11/7), is due to the young age of this xerophytic flora and its remoteness from eastern and western North American mountains. Among only 28 (!) species of petaloid, monocot families (by contrast richly represented in Armenia) all, except for a few species of *Allium*, have the Southern Hemisphere connections. In the Rhamnaceae (11/9) of the flora, the species of Madrean origin and southern connections prevail.

The remaining 44 families have 3–10 species each and contribute only 264 (13%) species to the flora. Sixteen families have only two species, and 27 families have only one species each. This type of spectrum illustrates an arid subtropical character of the flora of a recent age. It supports the inclusion of the Big Bend

TABLE 4. Western North American genera (+ W S North American). Numbers in parentheses: (total sp./sp. in Big Bend).

Fendlera (3/3 SW N Am)
Nama (45/7)
Phacelia (200/9)
Cryptantha (100/9)
Poliomintha (4/1 SW N Am)
Salazaria (1/1 SW N Am)
Dasylirion (1/1 SW N Am)
Nolina (15/2 SW N Am)
Cevallia (1/1 SW N Am)
Eucnide (8/1 SW N Am)
Jamecia (12/1)
Rhynchosida (2/1)
Sphaeralcea (60/6)
Acleisanthes (7/3 SW N Am)
Selinocarpus (9/3)
Camissonia (62/1)
Papaver sect. Agremone (28/4)
Platystigma (9/4)
Gilia (25/1)
Giliastrum (3/3 SW N Am)
Ipomopsis (24/5)
Eriogonum (250/15)
Schoenocrambe (4/1)
Stanleya (6/1)
Karwinskia (17/1)
Holodiscus (8/1)
Purshia (7/1)
Nerisyrenia (9/1)
Aloysia (58/2, to S America)
Bahia (15/4)
Encelia (15/1)
Flourensia (30/1)
Gutierrezia (20–30/4)
Helenium (40/3)
Heterosperma (5/1)
Hymenoxis (28/1)
Stevia (230/2)
Macharanthera (35/5)
Stephanomeria (24/2)
Telesperma (12/5)
Townsendia (25/1)
Xylorhiza (8/1)
Trixis (60/1 SW N Am)
Tridestomia (7/4 SW N Am)
Amsinckia (50/1)
Halimolobus (15/2)
Cleomella (10/1)
Ribes (150/3, temperate Eurasia, NW Africa)
Ibervillea (5/2 SW N Am)
Dalea (160/17, chiefly Mexico, SW N Am)
Lupinus (200/3 +Mediterranean, trop. Africa)
Escobaria (16/8)
Blepharidachne (4/1)
Hesperostipa (1/1 SW N Am)

region in the natural chorion Mega-Mexico 2 (Rzedowski 1993), as well as its good placement in the Sonoran Province (Thorne 1993) and the Western Region (McLaughlin 2007) of North America.

2. GENERA

Proportions of major geographic groups of genera, except cosmopolitan, in the Big Bend flora are illustrated by Tables 2, 3, and 4. More than two thirds of the genera have their origins in different parts of the Americas. Together with tropic-subtropical genera, the majority of which are also American, 78% of all the genera are restricted to the Western Hemisphere. West-east connections across the Northern Hemisphere are much weaker. Only 25% of all genera belong to northern (warm) temperate flora, while tropic-subtropical genera comprise 37% and illustrate the essentially American and warm temperate-subtropical character of the Big Bend region flora that has much more connections with the south, than with the north. Rzedowski (1993) stated that in the entire Mexican flora the southern connections are four times stronger than the northern ones.

1. North Temperate Old World Genera.—This group of 19 genera has 50 native species in the Big Bend flora. These are *Allium* (700 world /6 Big Bend/ 102 USA), *Linum* (180/8/36), *Limonium* (350/1/10), *Centaurea* (500/1/4), *Filago* (35/1/3), *Lactuca* (100/2/8), *Daucus* (22/1/2), *Lappula* (60/1/2), *Lithospermum* (60/5/8), *Omphalodes* (28/1/3), *Erysimum* (100/2/20), *Noccaea* (13/1/5), *Silene* (500/3/79), *Bassia* (26/1/6), *Corispermum* (70/1/9), *Krasheninnikovia* (9/1/1), *Helianthemum* (110/1/14), *Astragalus* (2200/9/349), *Polypogon* (15/4/8), and *Arundo* (5/1/1). Eurasian (EA) origin is well known from their distribution and is supported by phylogenetic data for several genera, like *Linum* (McDill et al. 2008) and *Limonium* (Lledo et al. 2005). Eurasian origin and migration via the Bering Land Bridge (BLB) with consecutive single colonization event to Andean South America were stated for *Astragalus* (Scherson et al. 2008) and *Silene* (Popp & Oxelman 2007). The majority of the genera in this group are of the young Neogene age (Popov 1963), with recent migration events to North America (NA) and from there to temperate South America. Their centers of diversity lie in different parts of the Tethyan Subkingdom: for *Centaurea* in Western Asia, for *Silene* in the Eastern Mediterranean-Western Asia, for *Limonium* in the Mediterranean, while the largest papilionoid genus *Astragalus* is in the first place in any Irano-Turanian flora. The genus *Allium* has a huge center in the Tethyan Subkingdom and an essential one in western North America. Most of these genera probably reached the Big Bend region from the north-west (via the BLB), fewer genera (*Helianthemum*, *Linum*, and *Limonium)* more likely crossed the

Atlantic. Lledo et al. (2005) stated a close connection of the North American *Limonium* species with northern European species of recent, Pliocene, age and an earlier migration of one species of a different clade to South America. Thus, independent migrations of *Limonium* species from the Western Mediterranean to the Americas in the Middle Miocene and in the Pliocene time could illustrate the recent pattern of Madrean and Tethyan disjunctions, as opposed to that of older genera migrated earlier in the Tertiary in both directions (Manchester 1999; Tiffney & Manchester 2001; Tiffney 2000).

2. Genera of Northern Latitudes and Mountains.—This group has genera with wide north temperate distribution including those with arcto-alpine species. Many of them have their major center of diversity in Eastern Asia (EA.), for example, *Arenaria* (China 102/world 300/Big Bend 5), *Androsace* (73/100/2), *Anemone* (53/120/2), *Clematis* (147/300/2), *Delphinium* (173/350/2), *Salix* (275/520/5), and *Gentiana* (248/361/1). More diverse in North America are *Draba* (world 350/ NA 102/ China 50/Big Bend 3) and *Aquilegia* (world 70–100/ NA 22/China 13/Big Bend 2). In North America they are mostly found in the western half, especially the Rocky Mountains and Great Basin. A North American genus *Epilobium* (world 165/NA 42/Big Bend 1) has seven sections most diverse in the Madrean Region or restricted to it, with the large section *Epilobium* diversified in all other continents except Antarctica (Katinas et al. 2004).

3. Relictual Widely North Temperate Genera.—This is a group of relictual genera, disjuncts of Eastern Asian-Eastern North American, as well as several smaller southern Eurasian regions of preservation of the Tertiary Laurasian flora. These are *Juglans* (world 21/Big Bend 2), *Fraxinus* (65/4), *Crataegus* (265/1), *Prunus* (430/3), *Ostrya* (7/1), *Lonicera* (200/1), *Vitis* (65/1), *Viburnum* (225/2), *Philadelphus* (75/4), *Cercis* (6/1), *Pseudotsuga* (6/2), and *Lespedeza* (40/1). It was suggested that *Juglans, Fraxinus,* and *Acer* have North American origin in the Eocene (Manchester 1999), while *Lonicera* and *Viburnum* (Bell & Donoghue 2005), as well as *Mahonia* (Wang et al. 2007) have E Asian origin and BLB crossing. *Symphoricarpos* (20/2) is mostly a NA genus with only one species in EA. *Pinus* (100/3) and *Mahonia* (110/2/) have more species in the Western, than the Eastern Region of North America. Together 30 north temperate genera of groups 2 and 3 have only 60 species (4%) in the Trans-Pecos flora. They occur mostly at higher elevations or are scattered on the canyon walls and along rivers (Powell 1998).

4. Widely Distributed Temperate Old World-New World Genera.—A group of 21 large genera of different (mostly Laurasian) origin widely distributed in temperate regions of both North and South Hemispheres. There are 80 species of the flora in these genera. Some of them have two centers of diversity: in Asia and in Mexico. The latter center is reflected in the Trans-Pecos flora by the high numbers of species in *Quercus* (500 world/150 Mexico/20 Big Bend), *Salvia* (900 world/325 Mexico/12 Big Bend/84 China/46 Ecuador, and a big center in Irano-Turania), and *Lithospermum* (60 World/5 Big Bend). A great antiquity and Laurasian affinities for Mexican *Salvia* were stated by Ramamoorthy (1993). Other genera have a big center in Asia and one (via the Beringian crossing) in western North America (*Artemisia*: 300 World/ 200 China/ 58 United States/5 Big Bend), or in Asia and in the Appalachian and Rocky Mountains (*Thalictrum* (150 world/73 China/ 23 US). Fewer genera of this type are of North American origin: *Solidago* (100 world/5 Big Bend/ 72 US/ 5 China). The remaining genera are almost cosmopolitan: *Marrubium, Lamium, Mentha, Stachys, Polemonium, Hieracium, Bromus, Poa, Rhamnus, Paronychia,* and others.

5. North American Genera.—This group has 37 genera/91 species (5.8% of the flora) of North American and 7 genera/11 species of Eastern North American (*Liatris, Ratibida,* and *Spermolepis)* origin. Most of them are of herbaceous habit and many are from Asteraceae. The larger genera have up to 8 sp. in the Big Bend flora (*Penstemon*: 265 total /8 Big Bend; *Erigeron*: 200/8; and *Castilleja*: 200/4). The smaller genera have 3 to 6 sp. in the region (*Matelea*: 150/4, *Lesquerella*: 40/6, *Helianthus*: 49/4, *Packera*: 67/3, *Gaillardia*: 28/4, and *Gaura*: 21/6).

6. Western North American Genera.—Table 4 has a list of 57 indigenous western NA wide genera that are very important in the plant cover. These genera contribute 170 species (10.6%) to the flora. This group should include as well 12 species of five small, but peculiar Apachian genera (*Fallugia, Engelmannia, Pseudoclappia, Fendlera,* and *Berlandiera*) and seven monotypous Chihuahuan genera (*Amblyolepis, Psathy-*

rotopsis, Emorya, Ariocarpus, Lophophora, Allolepis, and *Holacantha*). The Trans-Pecos flora has four of the renouned Madrean genera: *Foquieria, Chilopsis, Wislizenia,* and *Nectouxia*. Altogether there are 73 western North American genera with 193 sp. in the flora.

7. Amphitropical Genera.—There are 23 species of 10 amphitropial genera in the flora: *Krameria*: 18 total/3 Big Bend; *Larrea*: 5/1; *Tiquilia*: 20/5; *Koeberlinia*: 1/1; *Hoffmanseggia:* 28/3; *Gottea:* 1/1; *Trichloris:* 2/1; *Hedeoma:* 38/7; and *Scleropogon:* 1/1. They grow in warm arid and semiarid regions of temperate North and South America and have different evolutionary patterns involving long distance dispersals. For example, Simpson et al. (2004) stated that *Krameria* has two major clades each containing a North and a South American subclade. They result from two independent dispersals, or two vicariant episodes, involving North and South America. *Hoffmanseggia* arose in South America and had at least two dispersals to North America at different times (Simpson et al. 2005). *Tiquilia,* as stated by Moore and Jansen (2006), exhibits a North American origin and first divergence after greatest Cenozoic episode of rapid aridification near the Eocene/Oligocene boundary, major diversification in the NA deserts in the Miocene and four long distance dispersals to South America (Moore et al. 2006). The monotypic genus *Koeberlinia* of core brassicalean affinity is of North American deserts origin (Tobe & Raven 2008). For the American *Larrea* clade a separation from Old World *Zygophyllum* by sea floor spreading in the Cretaceous was proposed (Porter 1972; Sheahan & Chase 1996). The South American-North American Larreoideae has two out of the five genera in the Big Bend flora. Sheahan and Chase (2001) stated that they are of South American origin and recent, Late Neogene, time of arrival by long distance dispersal of the ancestors of *L. tridentata* to North American deserts.

Altogether, 82 western American genera with 204 sp. (14% of the flora) in groups 6 and 7 represent the core of the autochthonous xeric floristic complex of the south-western deserts in the Big Bend region flora. Many dominant and co-dominant species of the genera like *Foquieria, Larrea, Koeberlinia, Nolina, Dasylirion, Aloysia, Fallugia,* and others, are in these two groups. Most of them arose from the ancestors of Madro-Tertiary geoflora (Axelrod 1975; Raven & Axelrod 1978) affiliation. Fewer genera, for example, *Eriogonum, Nerisyrenia* and section Argemone of *Papaver,* are Cenozoic western North American (Madrean) derivatives of the ancestors from Arcto-Tertiary geoflora.

8. American-African Genera.—There are 20 genera with 57 sp. disjunctly distributed in America and Africa: *Thalinum, Thamnosma, Mimulus, Ambrosia, Coreopssis, Flaveria, Asclepias, Lupinus, Pomaria, Parkinsonia, Heteranthera, Sageretia, Sideroxylon, Nicotiana, Bouchea, Lantana, Tagetes, Calliandra, Galactia, Mimosa,* and *Sorgastrum*. Some of them, like *Mimosa* (6 sp.), *Asclepias* (12 sp.), *Lupinus* (3 sp.) and *Nicotiana* (3 sp.) are more specious in Big Bend and important in the plant cover. Transatlantic disjunctions of this group at the genus level were attributed to long-distance dispersal in both directions mostly by water, while species level disjunctions, to the anthropogenic factor (Renner 2004; Pennington et al. 2006; Simpson et al. 2006).

9. Madro-Tethyan Genera.—There are only 5 genera and 9 species that can be defined as Madro-Tethyan in the Big Bend flora. Some of those analyzed by Axelrod (1975), for example *Pistacia,* are not in the region, but grow not far from it, in the mountains of eastern-southern Mexico. Others, like *Quercus, Juniperus,* and *Pinus,* were considered in the group 3 or 4 of this classification, even though they have entire vicariant sections in the Tethyan and Madrean mountainous vegetation of low-middle altitudes. Some genera of Madro-Tethyan origin have a wider range today (e.g., *Cercis).* Because the present scheme follows contemporary ranges of taxa, these genera have been included in group 4 of north temperate relicts. Basalmost Cesalpinioideae was important in the Tertiary floras of subtropical littoral type (Mai 1995) and *Cercis* is in the Mediterranean element of many authors (Mai 1987; Kamelin 1983). In many cases, a convergent character of the Madrean and Tethyan similarities, much discussed in the literature (Axelrod 1975; Raven 1971, 1973), stems from the old age of such madro-tethyan genera. "The closer correspondence of woody taxa between the Madrean and Tethyan regions in the Tertiary time stems chiefly from a more favorable climate and terrain for a wider distribution" (Axelrod 1975:316).

The five Madro-Tethyan genera in the Big Bend flora are as follows:

Ephedra—35–70 extant species in Central and SW Asia, SW North America, Mexico, Mediterranean,

N Mediterranean Africa, and Andes from Ecuador to Patagonia. Four species grow in Trans-Pecos. Rydin et al. (2006) stated a striking increase in gnetalean diversity and wide distribution of *Ephedra* and *Ephedra*-like plants across Laurasia in the Early Cretaceous followed by a significant decline through the Late Cretaceous. Major groups of *Ephedra* originated after the final rifting of Gondwana (Rydin et al. 2004) and have good pollen record in Early Cretaceous paleoequatorial regions of Africa-South America (Crane 1996). Early Cretaceous fossils from Brazil, USA (Virginia), China, and Portugal very similar to extant *Ephedra*, suggest that crown group of *Ephedra* might be of Mesozoic origin (Rydin et al. 2004). North African-Mediterranean species are in a basal grade whereas all non-African species belong to a clade of Asian origin and New World species originated within the Asian clade (Rydin et al. 2004). Major center of diversity of extant Ephedra is in Central Asia (18 sp.) with pollen recorded for SW Siberia since the Upper Cretaceous (Peshkova 2005). Presence of an arid center in continental Asia since the Upper Carboniferous was stated by Kryshtofovich (1955). "Apparently, the same flora of Angarida or Tungussian Flora is ancestral to both the Permian xeric flora of Europe and Jurassic polichronous flora with its mesophytic characteristics. In the Upper Permian and Lower Triassic extensive orogenesis and lava intrusions in Asia brought about even larger expansion of the arid territories around the dry core of Asia" (Kryshtofovich 1957:46–47; cited and translated from Peshkova 2005).

Cupressus—28 taxa, 16 in W USA, Mexico to Central America, the rest in NW Africa, Middle East along Himalaya to SW and Central China (4 species) and N Vietnam (The Gymnosperm database). Recent phylogenetic research (Little 2006) stated the polyphyly of *Cupressus* with the 12 Old World species being sister to *Juniperus*. The 16 New World species of *Cupressus* plus *Callitropsis* were resolved as sister to the Old World *Cupressus* plus *Juniperus* clade.

Arbutus—14–20 sp., W North America, Central America, West Europe, Mediterranean, and SW Asia. A Laurasian origin for Ericaceae in the Late Cretaceous with the Arbutoideae in the basal clade was stated by Kron and Luteyn (2004). "A widespread common ancestor may have occurred along the coastline of the developing Tethyan seaway and subsequent vicariance may have been a major factor in the initial divergence of the ancestors of Arbutoideae, Ericoideae, and Vaccinioideae due to the continued drifting apart of Africa, Europe, and North America" (Kron & Luteyn 2004:498). The diversification of Arbutoideae along the Tethys seaway stated also by Hileman et al. (2001) might explain the contemporary disjunctions and is reminiscent of the pattern in other older Madro-Tethyan genera, like *Ephedra, Cercis, Cupressus*, pinions, and evergreen oaks.

Oligomeris—3 species, two of which are SW African, one *O. linifolia* from N Africa to W India, Canary Islands and southern and south-eastern United States and Mexico, all growing in desert vegetation (Kubitzki 2003). Resedaceae, an Old World family of Capparalean affinities (Kubitzki 2003), has 6 genera and ca. 85 sp., with a major center of diversity in the arid regions of the Mediterranean basin and two centers of differentiation, one in the western Mediterranean, and the other in the eastern Mediterranean and SW Asia (Martin-Bravo et al. 2007). It might have crossed the Atlantic by long distance, as the access to post Eocene NALB was restricted to cool-temperate and deciduous taxa (Tiffney 2000). Other younger Tethyan groups since the Neogene time with concentration in the Mediterranean basin (like Cistaceae and Limoniaceae) follow a similar pattern. Latest phylogeographic analysis also stated for *Oligomeris* a long-distance dispersal event from the Old World during the Quaternary (Martin-Bravo et al. 2009).

Peganum—5–6 species in the Mediterranean, southeast Europe, Transcaucasia, Middle Asia, Iran, Afghanistan, Mongolia, China, India; one species in eastern and north-central Mexico. Recent placement of Peganaceae in Nitrariaceae (Angiosperm Phylogeny Website) along with other Eastern Tethyan (Irano-Turanian) genera, *Nitraria* and *Malacocarpus*, makes the Tethyan origin of *Peganum* even more obvious.

10. Mega-Mexico II Genera (Rzedowski 1993).—Ten genera with 21 species of the flora have their ranges in Mexico and southern United States. All of them belong to Asteraceae, Cactaceae, and Poaceae.

11. Mega-Mexico III Genera (Rzedowski 1993).—Twenty six genera and 58 species have their ranges in Mexico, extending to southern United States as well as tropical Central and northern South America. Among them are *Agave* (100/, Agavaceae), *Echeandia* (12/1, Asphodellaceae), *Pilostiles* (25/1, Rafflesiaceae),

(*Bouwardia*, 20/1, Rubiaceae), *Leucophyllum* (12/3, Scrophulariaceae), 8 small asteraceous genera, and one of each family Cactaceae, Poaceae, and Amaranthaceae. Three small genera are present also in the West Indies: *Maurandella* (Scrophulariaceae), *Jefea* (Asteraceae), and *Garrya* (13/2, Garryaceae). Among the three Mesoamerican genera *Hechtia* (47/1, Bromeliaceae) extends northward to only 3 counties of southern Texas in the United States.

Altogether, there are 23 genera with 68 species of groups 10 and 11 in the Big Bend flora. Species of some of them (like *Agave, Leucophyllum, Garrya,* and *Echinocereus*) play a dominant role in the xeric communities of the Madrean vegetation.

12. Western and south-western United States, Mexico (northern) and Texas (southern United States) Genera.—Forty one peculiar genera with 70 sp. evolved in the Madro–Tertiary Geoflora have this type of range. Among those, six genera of the Cactaceae are most diverse. The remaining genera are from mostly tropical–warm temperate families like Apocynaceae (*Haplophyton*), Malvaceae (3), Nyctaginaceae (3), Rhamnaceae (*Adolphia*), Solanaceae (*Chamaesaracha*), and Verbenaceae (*Tetraclea*); largely tropical Rutaceae (*Choisya, Ptelea*) and Sapindoideae (*Ungandia*). The Asteraceae have 12 genera, papilionoid legumes have three, and endemic western North American family Crossosomataceae is monotypic. Prevalence of warm temperate-subtropical-tropical connections, some of those being very interesting, is evident from this list. For example, in core Rutaceae (Groppo et al. 2008) *Choisya* (4–5) and *Ptelea* (1–3) form a tropical American clade, *Zanthoxylum* is pantropical, and *Casimiroa-Dictamnus* clade has *Dictamnus* (1–2 sp. S Europe to N China), *Skimmia* (4 sp. east of the Himalayas to S Vietnam and the Philippines) and *Casimiroa* (Mexico, Costa Rica). Thus, core Rutaceae clade exemplifies both Madrean-tropical American connections and east to west Old World-New World (madro-tethyan) connections along the southern Tethys shore.

Among primarily north temperate families, the Brassicaceae has two and the Rosaceae has three genera (*Cercocarpus, Malacomeles,* and *Vaquelinia*) which exhibit this pattern of distribution. Six of the eight rosaceous genera in Trans-Pecos arose in the Madro-Tertiary Geoflora, with the remaining two genera being in common with the Old World.

13. Tropic-Subtropical American Genera.—There are 56 genera (119 sp.) in the flora with large distribution in tropical and subtropical parts of the Americas. Some of those are very peculiar and important in xeric desert and thorn shrub communities (*Condalia, Holocantha, Guajacum, Calliandra, Proboscidea, Mentzelia, Eryngium*, etc). The largest family in this group is Asteraceae (12 gen.).

14. Tropic-Subtropical Genera.—There are 47 genera (102 sp.) of pantropic-subtropical distribution in Trans-Pecos. The grasses (10 gen.) and the legumes (8 gen.) are most specious, including some dominant species (*Acacia,* 9 sp., *Prosopis,* 2 sp). Several Euphorbiaceae (4 gen.), like *Jatropa*, have interesting disjunctions; the same refers to the Rhamnaceae (*Colubrina, Ziziphus*) and *Buddleja*. The genus *Boerhavia*, Nyctaginaceae, has 8 out of its 20 species in the Big Bend flora.

15. Tropical to Warm Temperate Genera.—There are 42 tropic/subtropical genera (179 sp.) extending to warm temperate countries in the flora. The majority of them are grasses with 15 gen. /83 sp. (*Imperata, Pappophorum,* etc.), followed by Malvaceae (4/11), Cyperaceae (3/18), Amaranthaceae (2/12), *Senna* (10), *Heliotropium* (8), *Ipomoea* (8), *Kallstroemia* (5), and *Rhus* (4).

16. Mostly Tropical American Genera.—Twenty one genera with 64 species. Here are the legumes (4 gen./7 sp.), Cucurbitaceae (2 gen.), and others (*Tecoma, Tillandsia*). Eleven more genera and 50 sp. have wider distribution in the Americas, are important in the plant cover, and have their ranges centered primarily in Central and South America (*Baccharis,* 6 sp; *Opuntia*, 16 sp; and *Bouteloua,* 15 sp.).

17. Tropical genera.—Six genera with 10 sp. of pantropical distribution: *Cissus, Sesuvium, Rynchosia,* and three genera of the grasses.

18. Temperate-Subtropical American Genera.—Seven American genera with 41 sp. are widely distributed in north and south temperate and subtropical latitudes: *Oenothera* (11), *Verbena* (7), *Physalis* (6), etc.

19. Temperate-Subtropical Genera of North and South Hemispheres.—Nine genera with 21 species absent from the tropics have this type of wide distribution. Five of them are grasses (*Agrostis, Melica,* and

Hordeum). Most specious in this group is *Lycium* (5 sp). It has 70 species disjunctly distributed in temperate subtropical regions of South and North America, S Africa, Australia, and Eurasia. Fukuda et al. (2001) stated that *Lycium* originated in the New World, all the South African, Australian, and Eurasian species together are monophyletic and have a common ancestor from the New World. It was confirmed by recent data (Levin & Miller 2005) that the Old world *Lycium* species clade is nested within the American species, which comprise the rest of the Lycieae. This is another example of Madro-Tethyan connections, although the genus has a wider distribution. Species of *Lycium* grow in littoral (turgay) communities of dry regions in the Tethyan subkingdom.

20. Leptopus phyllantoides, tribe Poranthereae, Euphorbiaceae presents an interesting case.—An endemic NA clade of *Andrachne* section *Phyllanthopsis* (Vorontsova et al. 2007) includes two species disjunctly distributed in Trans-Pecos-Coahuila, Edwards Plateau and Ozarks Plateau. It is a relictual disjunctive type of range. This clade is sister to a clade of mesophyllous shrubs restricted to relictual humid forests of western Transcaucasia, Asia, and Indonesia plus a clade of evergreen rainforest understory trees of Asia and Australia (Vorontsova et al. 2007). These authors state that tribe Poranthereae appears to be centered in Africa, with movement to Asia, Australia, and the New World, and movement from subtropical arid habitats to wetter temperate and tropical ones. The basalmost clade combines microphyllous procumbent species of semi-deserts and has two subclades: the African-American (Somalia, Ethiopia/Mexico, and Peru) and the Asian/African subclade (Horn of Africa and N Africa/ Irano-Turania). The New World subclade of the basalmost clade indicates a single colonization and has two very similar amphitropical species of *Andrachne* in Baja California and Peru. Thus, we see another example of colonization of North America from both the northern route across Laurasia (section *Phyllanthopsis*), and along the southern Tethys shore across the Atlantic (the Mexican-Peruvian species).

This latter migration track seems very feasible for termophyllous ancient taxa originated or preserved in the Horn of Africa region. The importance of that region was stated by many researchers of Africa: "The high endemism of Horn of Africa emerges clearly....The flora of the Somali Republic is a remarkable one with very many outstandingly distinct species found nowhere else" (Brenan 1978:467). "The Somalian phytochorion could be seen as a hub for the arid truck" (Thulin 1994). "In historical terms it suggests that Horn of Africa would be a refuge area for the arid flora" (Friis & Balsev 2005).

The rest of the genera are cosmopolitan, or of wide temperate distribution, or have mostly non-native species in the flora.

CONCLUSIONS

The setting of the Big Bend region flora on the boundary of two subkingdoms of the Holarctic Kingdom explains its mixed character with combination of lineages evolved either from Madro-Tertiary or Arcto-Tertiary geoflora stock. However, the Madrean lineages predominate and the flora is mostly south-western North American by composition (Table 1). There are 1586 native species in 595 genera of 125 families in the Big Bend region flora. Many genera and families in the flora are monotypic or oligotypic.

Three quarters of the genera are restricted to the Western Hemisphere, and tropic/subtropical, mostly South American, genera have 37% of the species diversity in Trans-Pecos. Taxa with southern connections, especially the Madrean element which has 1056 species (or 66%) of the flora, prevail. The Chihuahuan Subprovince has a high level of endemism (26% of the flora) with many younger taxonomic groups, evolved in situ since the Cenozoic rapid aridification episode. It is well placed in the Sonoran Province, however, its boundary with the Tamaulipan Subprovince is very vague.

North Madrean and southern Rocky Mountains-Sonoran species (6% of the flora) are of either Madro-Tertiary or Arcto-Tertiary geoflora affiliation. The Apachian element is well represented (9% of the flora) which corroborates delineation of the namesake subprovince (McLaughlin 2007), while the Comanchian (2.5% of the flora) probably is a chorion of a lower rank.

East to west connections across the northern Hemisphere have a lesser weight in the flora. The older

Laurasian genera that migrated in the early Tertiary via one of the two northern bridges are not many in this younger flora. The NA-EA similarities are on the genus level and above. More recently migrated to the region are mostly progressive eastern Tethyan (mostly Irano-Turanian) genera which came from Asia via the BLB (Salsoleae, *Astragalus*).

Diversification of older Madro-Tethyan genera, like *Ephedra, Cercis, Arbutus, Cupressus,* pinions, and evergreen oaks along the Tethys seaway and recent long distance dispersal of younger genera from the Mediterranean (*Oligomeris, Limonium*) might explain contemporary pattern of the Madrean and Tethyan disjunctions. Another pattern (core Rutaceae) shows both Madrean-tropical American connections and Old World-New World connections along the Tethys shore. The southern east to west connections across the Atlantic along the southern Tethys shore are evident from several striking examples in Zygophyllaceae, tropical Boraginaceae, Rutaceae, succulent biome Fabaceae, Euphorbiaceae, Agavaceae/Dracenaceae and others.

APPENDIX 1

AREA DIAGNOSES FOR THE SPECIES OF BIG BEND REGION, TEXAS

The following list of species was extracted mostly from the Synthesis of the North American Flora (Kartesz & Meacham 2002) and it follows, with few exceptions, all the nomenclatural combinations as well as author citations of this source. The nomenclature and distributional data of the Onagraceae follows the Onagraceae website (Wagner & Hoch 2005) and the *Leptopus* clade follows Vorontsova et al. (2007). In the few cases where the nomenclature is different from that in the above mentioned sources, the author names are cited. The list below should be considered as a compilation for the purposes of areal descriptions rather than a comprehensive checklist. The families of vascular plants are arranged in the alphabetical order as are genera and species. Numbers by each family name indicate species/genera ratios in the family.

ACANTHACEAE: 18/8
Anisacanthus linearis Chihuahuan
Anisacanthus puberulus Chihuahuan
Anisacanthus quadrifidus Chihuahuan
Carlowrightia arizonica Sonoran
Carlowrightia linearifolia Apachian
Carlowrightia mexicana Tr-Pecos-Coahuila
Carlowrightia parvifolia Tr-Pecos-Coahuila
Carlowrightia serpyllifolia Tr-Pecos-Coahuila
Carlowrightia texana Chihuahuan
Dyschoriste linearis SC US
Dyschoriste schiedeana Sonoran-Chihuahuan
Elytraria imbricata Mesoam-Madrean
Justicia pilosella Chihuahuan-Tamaulipan
Justicia warnockii Tr-Pecos
Ruellia corzoi Chihuahuan
Ruellia parryi Chihuahuan
Stenandrium barbatum Chihuahuan
Tetramerium nervosum Sonoran

ACERACEAE: 1/1
Acer grandidentatum N Madrean Mont. (S Rocky M-E Great Basin-Sonoran Province)

AGAVACEAE: 10/2
Agave glomeruliflora Chihuahuan
Agave gracilipes Chihuahuan
Agave havardiana Tr-Pecos Endemic
Agave lechuguilla Chihuahuan
Agave parryi Sonoran
Yucca baccata SW US
Yucca elata Sonoran-Chihuahuan
Yucca faxoniana Chihuahuan
Yucca thompsoniana Chihuahuan
Yucca torreyi Chihuahuan

AIZOACEAE: 1/1
Sesuvium verrucosum American Trop/Subtr

ALISMATACEAE: 1/1
Sagittaria calycina N American

AMARANTHACEAE: 22/7
Alternanthera caracasana Tropical American
Amaranthis acanthochiton Chihuahuan
Amaranthus albus Polichorous
Amaranthus arenicola Prairie with radiations
Amaranthus blitoides N American (WC)
Amaranthus crassipes Caribbean
Amaranthus palmeri N American (SWC)
Amaranthus polygonoides Caribbean
Amaranthus powellii Cordilleran
Amaranthus retroflexus N American (polychorous)
Amaranthus scleropoides Chihuahuan-Tamaulipan
Amaranthus torreyi W Sonoran
Froelichia arizonica Sonoran-Chihuahuan
Froelichia gracilis N American
Gomphrena nitida Sonoran wide
Guilleminea densa Madrean
Iresine heterophylla Sonoran wide
Iresine leptoclada Chihuahuan
Tidestromia carnosa Chihuahuan
Tidestromia gemmata Chihuahuan
Tidestromia lanuginosa SW & SC US
Tidestromia suffruticosa Chihuahuan

ANACARDIACEAE: 4/1
Rhus lanceolata SC US-Chihuahuan
Rhus microphylla Sonoran-Chihuahuan wide
Rhus trilobata W N American (+ W Prairie)
Rhus virens E Madrean

ANEMIACEAE: 1/1
Anemia mexicana Mesoam

APIACEAE: 7/5
Ammoselinum popei S Prarie
Cyclospermum leptophyllum S N American
Daucus pusillus N American
Eryngium heterophyllum W & S Madrean
Eryngium leavenworthii S Prairie
Spermolepis echinata S N American
Spermolepis inermis C & S Prarie-Appalachian

APOCYNACEAE: 8/4
Amsonia longiflora Chihuahuan
Amsonia palmeri N Sonoran Province
Apocynum cannabinum N American
Haplophyton crooksii N Sonoran-Chihuahuan
Telosiphonia hypoleuca J Davis c, Madrean Mont
Telosiphonia lanuginosa Madrean Mont (East)
Telosiphonia macrosiphon Tr-Pecos-Coahuila

ARALIACEAE: 1/1
Aralia racemosa ssp. bicrenata SW N American

ARISTOLOCHIACEAE: 2/1
Aristolochia coryi S TX Endemic (SW-SC TX)
Aristolochia wrightii Chihuahuan

ASCLEPIADACEAE: 23/4
Asclepias asperula SWC N American
Asclepias brachystephana Sonoran-Chihuahuan
Asclepias engelmanniana Prairie-SWC US
Asclepias glaucescens (Sonoran)-Mesoam
Asclepias latifolia S Prairie–SW US
Asclepias nummularia Sonoran Subprovince
Asclepias oenotheroides SC US-Mesoam
Asclepias scaposa Chihuahuan disjunct ?
Asclepias sperryi Tr-Pecos-Coahuila
Asclepias subverticillata SW US-Chihuahuan
Asclepias texana N Chihuahuan-Coahuila
Asclepias viridiflora N American
Cynanchum barbigerum Tamaulipan
Cynanchum pringlei Chihuahuan
Cynanchum racemosum N Chihuahuan-Tamaulipan
Funastrum crispum SWC US-Chihuahuan
Funastrum cynanchoides N & W Madrean
Funastrum torreyi Chihuahuan-Tamaulipan
Matelea parvifolia N Madrean
Matelea producta N & W Madrean
Matelea reticulata Chihuahuan-Tamaulipan
Matelea texensis Tr-Pecos Endemic
Matelea sagittifolia S TX Endemic

ASPLENIACEAE: 3/1
Asplenium palmeri J Davis c. Mesoam-Madrean Mont
Asplenium resiliens N American
Asplenium trichomanes J Davis c. Holarctical

ASTERACEAE: 230/107
Acourtia nana Sonoran-Chihuahuan
Acourtia runcinata Chihuahuan-Tamaulipan
Acourtia wrightii Sonoran-Chihuahuan
Ageratina herbacea Madrean (SWC US)
Ageratina rothrockii Sonoran-Chihuahuan
Ageratina wrightii Chihuahuan
Amblyolepis setigera Chihuahuan-Tamaulipan
Ambrosia confertiflora SW & SC US. N Madrean
Ambrosia psilostachya N American-Mesoam
Amphiachyris dracunculoides Prairie
Aphanostephus ramosissimus ?
Aphanostephus riddellii SC US (W TX-Chihuahuan)
Artemisia campestris Holarctical
Artemisia carruthii SWC N American
Artemisia dracunculus Holarctical
Artemisia filifolia WC US
Artemisia ludoviciana N American
Astranthium robustum Tr-Pecos Endemic
Baccharis bigelovii Chihuahuan
Baccharis havardii Chihuahuan
Baccharis pteronioides Madrean wide
Baccharis salicifolia American Trop/Subtr
Baccharis salicina Prairie. WC N American
Baccharis wrightii SW N American
Bahia absinthifolia Sonoran-Chihuahuan
Bahia bigelovii Tr-Pecos Endemic
Bahia dissecta WC US Mont (Rocky M)
Bahia pedata S Rocky M-Chihuahuan
Baileya multiradiata Madrean (no Mexican Highlands)
Berlandiera lyrata Madrean
Bidens bigelovii SWC US-N Chihuahuan ?
Bidens laevis American Trop/Subtr
Bidens leptocephala Apachian
Borrichia frutescens Pecos c. Atlantic&Gulf Coast
Brickellia californica W N American
Brickellia conduplicata Chihuahuan Mont
Brickellia coulteri W Sonoran Province
Brickellia eupatorioides N American (not Pacific)
Brickellia grandiflora W N American
Brickellia hinckleyi Tr-Pecos Endemic
Brickellia laciniata Chihuahuan wide
Brickellia veronicifolia Chihuahuan-Mexican Highlands
Calyptocarpus vialis Mesoam-Gulf Coast
Carminatia tenuiflora Madrean Mont
Carphochaete bigelovii N Sonoran-Chihuahuan
Centaurea americana SW-SC US (S Prairie-Apachian)
Chaetopappa bellioides Chihuahuan-Tamaulipan
Chaetopappa ericoides WC N American
Chaetopappa parryi Chihuahun-Tamaulipan
Chaptalia texana E Madrean Mont
Chloracantha spinosa Mesoam-Madrean
Chrysactinia mexicana E Madrean Mont
Cirsium ochrocentrum WC US
Cirsium texanum Comanchian
Cirsium turneri S TX-Coahuila Endemic
Cirsium undulatum WC N American (Prairie-W US)
Conoclinium dissectum Chihuahuan
Conyza canadensis American
Coreopsis tinctoria N American
Cosmos parviflorus Apachian-Mexican Highlands
Dyssodia papposa Mesoam-N American

Eclipta prostrata American with radiations
Encelia scaposa N Chihuahuan
Engelmannia peristenia S Prairie-(S Rocky M-Chihuahuan)
Ericameria laricifolia N Madrean
Erigeron bellidiastrum WC N American
Erigeron bigelovii Chihuahuan
Erigeron colomexicanus ?
Erigeron divergens W N American
Erigeron eximius J Davis c. WN American Mont (Rocky M-Colorado-Apachian Mont)
Erigeron flagellaris W N American Mont
Erigeron modestus SWC US ?
Erigeron versicolor ?
Evax verna SC US (S Prairie)
Flaveria trinervia Mesoam with radiations
Flourensia cernua Sonoran wide
Flyriella parryi (ES) Chihuahuan
Gaillardia multiceps ?
Gaillardia pinnatifida SW US (not Cal)
Gaillardia pulchella N American (mostly S-C)
Gaillardia suavis S Prairie
Galinsoga parviflora American
Grindelia arizonica Apachian
Grindelia grandiflora J Davis c. N Chihuahuan
Grindelia havardii SW TX & SW AZ Endemic
Grindelia nuda SWC US
Grindelia oxylepis S Chihuahuan-(Mexican Highlands)
Grindelia scabra N Chihuahuan
Gutierrezia microcephala Madrean (no Mexican Highlands)
Gutierrezia sarothrae W N American
Gutierrezia sphaerocephala Chihuahuan-Tamaulipan
Gutierrezia texana Comanchian-Chihuahuan
Gymnosperma glutinosum Mesoam
Haploesthes greggii SW Prairie-Chihuahuan
Hedosyne ambrosiifolia Sonoran-Chihuahuan
Helenium amarum E N American
Helenium elegans Comanchian-Chihuahuan-Tamaulipan
Helenium microcephalum S Prairie-Chihuahuan-Tamaulipan
Helenium microcephalum var. *ooclinium* Chihuahuan
Helianthus annuus N American-Polichorous
Helianthus ciliaris SC N American
Helianthus niveus Sonoran proper (W Madrean)
Helianthus paradoxus Pecos, Reevs cc. ?
Heliomeris longifolia Madrean disjunctive
Heliomeris multiflora Rocky M
Heliopsis parvifolia N Madrean Mont
Heterosperma pinnatum Mesoam-Madrean
Heterotheca canescens SC-SW Prairie
Heterotheca fulcrata W US Mont
Heterotheca subaxillaris N American
Heterotheca villosa W N American
Heterotheca viscida N Chihuahuan (+ S AZ)
Hieracium carneum S Great Basin-N Chihuahuan (+ S AZ) Mount disjunctive
Hieracium schultzii Mesoam
Hymenoclea monogyra N Madrean
Hymenopappus flavescens SW US
Hymenopappus scabiosaeus Prairie
Hymenoxys odorata SW Prairie-N Madrean
Isocoma pluriflora Chihuahuan
Iva angustifolia J Davis c. ?
Jefea brevifolia Chihuahuan
Koanophyllon solidaginifolium Chihuahuan
Lactuca graminifolia Apachian (SW US)
Laennecia coulteri N Madrean
Laennecia filaginoides Mesoam-S American
Laennecia sophiifolia Amphitropical ?
Leuciva dealbata Chihuahuan
Liatris punctata Prairie
Lygodesmia ramosissima Sonoran-Chihuahuan
Lygodesmia texana S Prairie-Chihuahuan
Machaeranthera blephariphylla N Chihuahuan ?
Machaeranthera gracilis N Madrean
Machaeranthera gypsophila Chihuahuan
Machaeranthera pinnatifida Prairie-Madrean
Machaeranthera tanacetifolia W Prairie-S Rocky M-Madrean
Melampodium leucanthum SWC US
Melampodium strigosum J Davis c. Sonoran-Chihuahuan ? (+ Colorado)
Nicolletia edwardsii Chihuahuan
Packera millelobata Chihuahuan
Packera neomexicana Apachian
Packera plattensis J Davis c. EC Prairie
Palafoxia callosa Comanchian extending to MO
Palafoxia riograndensis Chihuahuan
Palafoxia sphacelata E Prairie
Parthenium argentatum Chihuahuan-Mexican Highlands
Parthenium confertum Chihuahuan-Tamaulipan
Parthenium incanum Madrean wide
Pectis angustifolia WC N America
Pectis filipes Sonoran-Chihuahuan
Pectis papposa Madrean (no Mex. Highlands)
Pectis prostrata Mesoam-Central American
Pericome caudata N Madrean
Perityle aglossa Tr-Pecos-Coahuila
Perityle angustifolia SW TX Endemic
Perityle bisetosa Chihuahuan
Perityle cinerea Tr-Pecos Endemic
Perityle dissecta Chihuahuan
Perityle parryi Chihuahuan
Perityle quinqueflora Chihuahuan
Perityle rupestris Chihuahuan
Perityle vaseyi Chihuahuan
Perityle vitreomontana Brewster c Endemic
Pinaropappus roseus Madrean-Mesoam
Pluchea sericea N Madrean
Porophyllum greggii Chihuahuan
Porophyllum ruderale American Trop/Subtr
Porophyllum scoparium Chihuahuan wide
Psathyrotopsis scaposa Chihuahuan
Pseudoclappia arenaria Pecos c. S Rocky M-N Chihuahuan (Coahuila)
Pseudognaphalium arizonicum Sonoran-Chihuahuan
Pseudognaphalium canescens W N American
Pseudognaphalium jaliscense ?
Pseudognaphalium pringlei Sonoran-Chihuahuan

Pseudognaphalium stramineum W N American
Pseudognaphalium viscosum Mesoam
Psilactis asteroides Sonoran-Chihuahuan
Psilactis brevilingulata Chihuahuan (Amphitropical)
Psilostrophe gnaphalioides Chihuahuan-Tamaulipan
Psilostrophe tagetina SWC US
Ratibida columnifera Prairie wide
Ratibida tagetes SWC US
Sanvitalia procumbens Mesoam
Schkuhria multiflora Amphitropical
Senecio flaccidus Madrean wide
Senecio parryi N Sonoran -Chihuahuan
Senecio riddellii W Prairie
Senecio wootonii J Davis, Pecos cc. SWC N American
Simsia calva Chihuahuan-Tamaulipan
Solidago canadensis N American
Solidago gigantea N American
Solidago juliae Chihuahuan
Solidago velutina W N American (not Pacific)
Solidago wrightii S Rocky M-W Madrean
Stephanomeria minor W N American
Stephanomeria pauciflora W N American
Stevia ovata Mesoam-S American
Stevia serrata J Davis c. Mesoam
Symphyotrichum divaricatum ?
Symphyotrichum ericoides N American
Symphyotrichum expansum ?
Symphyotrichum falcatum WC N American (W Prairie wide)
Symphyotrichum lanceolatum J Davis c. N American
Symphyotrichum subulatum American (coastal) Polichorous
Tagetes micrantha Mesoam-Madrean
Tetragonotheca texana Chihuahuan-Tamaulipan
Tetraneuris linearifolia S Prairie-Chihuahuan-Tamaulipan
Tetraneuris scaposa W Prairie-Chihuahuan-Tamaulipan
Thelesperma ambiguum Tamaulipan
Thelesperma filifolium Prairie
Thelesperma longipes Chihuahuan (+ S AZ)
Thelesperma megapotamicum Prairie, secondarily Amphitropical
Thelesperma simplicifolium Chihuahuan (Tamaulipan ?)
Thymophylla acerosa N Madrean wide
Thymophylla aurea ?
Thymophylla micropoides Chihuahuan
Thymophylla pentachaeta Madrean
Thymophylla setifolia Chihuahuan
Townsendia exscapa W N American
Trixis californica N Madrean
Verbesina encelioides Amerrican
Verbesina nana Chihuahuan
Verbesina oreophila Chihuahuan Mont
Verbesina virginica J Davis c. E N American
Vernonia larsenii Chihuahuan
Vernonia marginata W Prairie-Chihuahuan
Viguiera cordifolia N Sonoran-Chihuahuan
Viguiera dentata Mesoam-Madrean
Viguiera stenoloba Madrean (Chihuahuan wide)
Wedelia texana Chihuahuan-Tamaulipan
Xanthocephalum gymnospermoides J Davis c. Sonoran-Chihuahuan
Xylorhiza wrightii Chihuahuan
Xylothamia triantha Chihuahuan
Zinnia acerosa Madrean wide
Zinnia anomala Chihuahuan
Zinnia grandiflora S Rocky M-Sonoran wide

AZOLLACEAE: 1/1
Azolla mexicana C & N American

BERBERIDACEAE: 2/1
Mahonia haematocarpa Sonoran
Mahonia trifoliolata Sonoran

BETULACEAE: 1/1
Ostrya virginiana Appalachian. E N American

BIGNONIACEAE: 2/2
Chilopsis linearis Sonoran wide
Tecoma stans American Trop/Subtr

BORAGINACEAE: 33/9
Amsinckia menziesii W US
Antiphytum floribundum E & S Madrean
Antiphytum heliotropioides S Chihuahuan (Coahuila)
Cryptantha albida Sonoran-Chihuahuan
Cryptantha angustifolia SW N American
Cryptantha cinerea W N American
Cryptantha crassipes Endemic for Otero, NM, & Brewster, TX, cc. N Chihuahuan
Cryptantha crassisepala Sonoran wide
Cryptantha mexicana Chihuahuan
Cryptantha oblata Endemic S NM – SW TX
Cryptantha palmeri Chihuahuan
Cryptantha pusilla Sonoran-Chihuahuan
Hackelia pinetorum SW US (AZ, NM, SW TX)
Heliotropium confertifolium Chihuahuan
Heliotropium convolvulaceum WC N American
Heliotropium curassavicum American
Heliotropium glabriusculum Chihuahuan
Heliotropium greggii Chihuahuan
Heliotropium molle Chihuahuan
Heliotropium procumbens Caribbean with irradiations to N & S America. American
Heliotropium torreyi Chihuahuan-Tamaulipan
Lappula occidentalis W N American
Lithospermum cobrense Apachian-SMO
Lithospermum incisum W US-Prairie wide
Lithospermum mirabile S TX Endemic
Lithospermum multiflorum S WC US
Lithospermum viride Chihuahuan rare
Omphalodes aliena Chihuahuan narrow
Tiquilia canescens Madrean
Tiquilia gossypina Chihuahuan
Tiquilia greggii Chihuahuan
Tiquilia hispidissima Chihuahuan
Tiquilia mexicana Chihuahuan

BRASSICACEAE: 43/21
Arabis fendleri W N American (Great Basin-S Rocky M)
Cardamine macrocarpa Chihuahuan, rare

Descurainia incana J Davis c. W N American
Descurainia pinnata N American (mostly W)
Dimorphocarpa wislizeni N Sonoran–S Rocky M
Draba cuneifolia W & SC N American
Draba platycarpa W & SC US disjunct
Draba standleyi Apachian ? Rare
Erysimum asperum Prairie (mostly W)
Erysimum capitatum W N American
Halimolobos diffusa Sonoran Mont
Lepidium alyssoides S Rocky M-E Great Basin
Lepidium austrinum SC N American
Lepidium densiflorum N American
Lepidium lasiocarpum Great Basin-Sonoran
Lepidium oblongum S & C N American
Lepidium sordidum Chihuahuan
Lepidium virginicum N American
Lesquerella argyraea Chihuahuan
Lesquerella fendleri S Rocky M-(SE Great Basin)-Sonoran
Lesquerella gordonii Sonoran-SE Prairie
Lesquerella mcvaughiana Brewster & Pecos cc Endemic
Lesquerella ovalifolia C Prairie-N Sonoran
Lesquerella purpurea N Sonoran proper
Mancoa pubens N Sonoran-Chihuahuan disjunct
Nerisyrenia camporum Chihuahuan proper
Noccaea montana W US Mont not Cal Province
Pennellia longifolia J Davis c. S Great Basin-Sonoran
Pennellia micrantha S Great Basin-Sonoran
Rorippa ramosa Chihuahuan rare
Rorippa teres Gulf Coast
Schoenocrambe linearifolia W N American
Selenia dissecta N Sonoran-Chihuahuan disjunct
Sisymbrium auriculatum Chihuahuan
Stanleya pinnata W N American
Streptanthus carinatus N (Sonoran) Chihuahuan
Streptanthus cutleri Brewster c. Endemic
Streptanthus platycarpus SW TX Endemic
Synthlipsis greggii Chihuahuan
Thelypodiopsis purpusii SW US (?)
Thelypodium tenue Tr-Pecos Endemic
Thelypodium texanum Tr-Pecos Endemic
Thelypodium wrightii SW US (Apachian ?)

BROMELIACEAE: 2/2
Hechtia texensis Tr-Pecos Endemic (Big Bend)
Tillandsia recurvata American Trop/Subtr

BUDDLEJACEAE: 3/2
Buddleja marrubiifolia Chihuahuan
Buddleja scordioides E Madrean
Emorya suaveolens Tr-Pecos-Coahuila

CACTACEAE: 56/17
Ariocarpus fissuratus Chihuahuan
Coryphantha echinus Chihuahuan
Coryphantha macromeris Chihuahuan
Coryphantha ramillosa Chihuahuan (Coahuila)
Coryphantha robustispina Sonoran-Chihuahuan
Cylindropuntia davisii Chihuahuan+ SWC US
Cylindropuntia imbricata S N American
Cylindropuntia kleiniae Sonoran-Chihuahuan
Cylindropuntia leptocaulis Chihuahuan-Tamaulipan
Cylindropuntia tunicata Madrean + Ecuador, Peru
Echinocactus horizonthalonius Chihuahuan
Echinocactus texensis Chihuahuan-Tamaulipan+ SWC US
Echinocereus chisoensis ?
Echinocereus coccineus SW US-Sonoran wide (no Cal)
Echinocereus dasyacanthus Chihuahuan
Echinocereus enneacanthus Chihuahuan-Tamaulipan
Echinocereus pectinatus Chihuahuan-Tamaulipan
Echinocereus pseudopectinatus ?
Echinocereus russanthus Brewster c. Endemic
Echinocereus stramineus Chihuahuan
Echinocereus viridiflorus W Prairie-Chihuahuan
Echinomastus intertextus Sonoran-Chihuahuan
Echinomastus mariposensis Chihuahuan
Echinomastus warnockii Chihuahuan
Epithelantha micromeris Sonoran-Chihuahuan
Escobaria albicolumnaria Chihuahuan
Escobaria dasyacantha Chihuahuan
Escobaria duncanii Chihuahuan
Escobaria hesteri Tr-Pecos Endemic
Escobaria minima Brewster c. Endemic
Escobaria tuberculosa Chihuahuan
Escobaria vivipara W N American
Ferocactus hamatacanthus Chihuahuan-Tamaulipan
Glandulicactus uncinatus var. *wrightii* Chihuahuan
Grusonia aggeria Tr-Pecos-Coahuila
Grusonia emoryi Chihuahuan
Grusonia grahamii Tr-Pecos
Grusonia schottii Chihuahuan-Tamaulipan
Lophophora williamsii Chihuahuan-Tamaulipan
Mammillaria grahamii Sonoran-Chihuahuan
Mammillaria heyderi Sonoran wide (+Tamauilipas)
Mammillaria heyderi var. *meiacantha* Apachian
Mammillaria lasiacantha Sonoran-Chihuahuan
Mammillaria pottsii Chihuahuan
Neolloydia conoidea Chihuahuan-Tamaulipan
Opuntia atrispina S TX Endemic
Opuntia aureispina Brewser c. Endemic
Opuntia engelmannii Sonoran wide
Opuntia engelmannii var. *lindheimeri* SC N American (Chihuahuan-Tamaulipan)
Opuntia macrocentra Sonoran wide
Opuntia macrorhiza C N American
Opuntia phaeacantha SW N American
Opuntia polyacantha W N American
Opuntia rufida Chihuahuan
Peniocereus greggii Sonoran wide
Thelocactus bicolor Chihuahuan-Tamaulipan

CALLITRICHACEAE:1/1
Callitriche heterophylla J Davis c. C&N American

CAMPANULACEAE: 6/3
Campanula rotundifolia Holarctical (Palearctical)
Lobelia berlandieri Chihuahuan
Lobelia cardinalis N American
Lobelia fenestralis Tr-Pecos, AZ, Mexico, SW NM Disjunct Mont

Triodanis holzingeri CS Prairie
Triodanis perfoliata N American

CAPPARACEAE: 6/5
Cleome multicaulis Disjunct: AZ. CO. TX, WO. S Rocky M-W Madrean
Cleomella longipes Sonoran-Chihuahuan (W)
Koeberlinia spinosa Amphitropical (NW Sonoran-Chihuahuan)
Polanisia dodecandra N American
Polanisia uniglandulosa Madrean (Mexican Highlands–N&E Madrean)
Wislizenia refracta Sonoran

CAPRIFOLIACEAE: 5/3
Lonicera albiflora SWC US disjunct mont
Symphoricarpos longiflorus N Madrean
Symphoricarpos palmerii N Madrean
Viburnum australe J Davis c, rare, also in Mexico ?
Viburnum rufidulum J Davis c. E N American

CARYOPHYLLACEAE: 15/5
Arenaria benthamii SC US. C-S Texas
Arenaria fendleri J Davis c. S Rocky M-S Great Basin-Apachian
Arenaria lanuginosa Davis c. N American ?
Arenaria livermorensis J Davis c. Tr-Pecos Endemic
Arenaria ludens Tr-Pecos-Coahuila
Cerastium axillare Chihuahuan
Drymaria laxiflora Chihuahuan
Drymaria leptophylla SWC N American (Sonoran ?)
Drymaria molluginea J Davis c. SWC N American
Drymaria pachyphylla N Chihuahuan
Paronychia jamesii SC US
Paronychia monticola Tr-Pecos –Coahuila Mont
Paronychia wilkinsonii Chihuahuan Mont
Silene antirrhina N American
Silene laciniata Madrean wide

CELASTRACEAE: 4/3
Celastrus scandens N American (NE-NC)
Mortonia sempervirens Chihuahuan
Mortonia scabrella N Sonoran- Chihuahuan
Schaefferia cuneifolia Chihuahuan

CERATOPHYLLACEAE: 1/1
Ceratophyllum demersum Polychorous

CHENOPODIACEAE: 21/6
Atriplex acanthocarpa Chihuahuan
Atriplex canescens W US (+ Chihuahua)
Atriplex elegans N Madrean
Atriplex obovata SE Great Basin-S Rocky M-Chihuahuan
Atriplex wrightii SW-C US + N Mexico
Chenopodium berlandieri N American
Chenopodium cycloides E CS Prairie
Chenopodium fremontii W N American
Chenopodium incanum W N American
Chenopodium graveolens Amphitropical
Chenopodium leptophyllum W N American
Chenopodium neomexicanum SW US
Chenopodium murale Polichorous (Palearctic)
Chenopodium pallescens Presidio c. ?
Chenopodium pratericola N American
Corispermum americanum WC N American
Cycloloma atriplicifolium N American
Krascheninnikovia lanata W N American
Monolepis nuttalliana W N American
Suaeda suffrutescens var. *suffrutescens* Apachian-Chihuahuan (+ OK)

CISTACEAE: 2/2
Helianthemum glomeratum C American
Lechea mensalis Chisos Mont. Brewster c Endemic

COMMELINACEAE: 6/2
Commelina dianthifolia S Rocky M- Madrean
Commelina erecta E N American
Tradescantia brevifolia Tr-Pecos-Coahuila Mont
Tradescantia leiandra Chihuahuan
Tradescantia occidentalis Prairie wide
Tradescantia wrightii N Chihuahuan

CONVOLVULACEAE: 16/6
Bonamia ovaliifolia N Chihuahuan
Bonamia repens N Chihuahuan
Convolvulus equitans SWC N American
Cressa truxillensis Madrean
Dichondra argentea Chihuahuan
Dichondra brachypoda Chihuahuan
Evolvulus alsinoides Madrean
Evolvulus nuttallianus WC N American
Evolvulus sericeus J Davis c. American Trop/Subtr
Ipomoea capillacea C American
Ipomoea cardiophylla American Trop/Subtr
Ipomoea costellata Sonoran
Ipomoea cristulata Sonoran
Ipomoea lindheimeri Chihuahuan
Ipomoea rupicola N Chihuahuan
Ipomoea tenuiloba Sonoran

CRASSULACEAE: 6/3
Echeveria strictiflora Chihuahuan
Sedum cockerellii J Davis c. AZ+NM
Sedum havardii Tr-Pecos-Coahuila
Sedum nanifolium Pecos-Coahuila Endemic
Sedum wrightii SWC N American
Villadia squamulosa Chihuahuan

CROSSOSOMATACEAE: 1/1
Glossopetalon spinescens W N American

CUCURBITACEAE: 8/6
Apodanthera undulata Sonoran-Chihuahuan
Cucurbita digitata Madrean
Cucurbita foetidissima Madrean wide (radiations to WC US)
Cyclanthera dissecta Mesoam-Madrean
Ibervillea lindheimeri Comanchian-Caribbean ?
Ibervillea tenuisecta Chihuahuan
Melothria pendula E N American (Gulf Coast)
Sicyos microphyllus Mesoam

CUPRESSACEAE: 8/2
Cupressus arizonica Madrean wide disjunct

Juniperus ashei Comanchian
Juniperus coahuilensis Sonoran-Chihuahuan (wide)
Juniperus deppeana Madrean
Juniperus flaccida Brewster c. only in US. Madrean
Juniperus monosperma Madrean
Juniperus pinchotii SC US
Juniperus scopulorum W N American

CUSCUTACEAE: 6/1
Cuscuta applanata ?
Cuscuta indecora N American
Cuscuta leptantha ?
Cuscuta pentagona American
Cuscuta squamata Chihuahuan
Cuscuta umbellata ?

CYPERACEAE: 40/10
Bulbostylis capillaris American (Amphipacific)
Bulbostylis juncoides S Mesoam
Carex agrostoides Sonoran-Chihuahuan (N)
Carex athrostachya J Davis c. W N American
Carex frankii E N American
Carex hystericina Presidio c N American
Carex mesochorea E N American
Carex microdonta CS Prairie
Carex muriculata Pecos c. Chihuahuan
Carex occidentalis J Davis c. W N American
Carex planostachys SC US-E Madrean + Florida
Cladium mariscus Trop/Subtr
Cyperus acuminatus J Davis, Presidio cc. N American
Cyperus echinatus E N American
Cyperus elegans Mesoam-S American
Cyperus esculentus American-African (Polichorous)
Cyperus flavicomus J Davis c ?
Cyperus laevigatus Trop/Subtr
Cyperus niger American (Trop/Subtr)
Cyperus odoratus American
Cyperus pseudothyrsiflorus SC US (TX, N Mexico)
Cyperus retroflexus S N American
Cyperus seslerioides American (Trop/Subtr)
Cyperus spectabilis Madrean wide
Cyperus sphaerolepis Madrean
Cyperus squarrosus American-African
Eleocharis albida Atlantic-Gulf Coast
Eleocharis cylindrica Presidio c. Amphitropical
Eleocharis geniculata American-African
Eleocharis macrostachya American
Eleocharis montevidensis American
Eleocharis parishii Presidio c Madrean wide
Eleocharis parvula Holarctical
Fimbristylis annua American
Fuirena simplex N American-Mesoam
Lipocarpha aristulata N American
Lipocarpha micrantha American
Schoenoplectus acutus J Davis c. N American
Schoenoplectus maritimus Holarctical
Schoenoplectus pungens Polichorous

DENNSTAEDTIACEAE: 1/1
Pteridium aquilinum Holarctical

DRYOPTERIDACEAE: 4/2
Phanerophlebia umbonata Tamaulipan-Chihuahuan
Woodsia neomexicana Apachian
Woodsia phillipsii Sonoran Subprovince
Woodsia plummerae Sonoran-N Chihuahuan

EBENACEAE: 1/1
Diospyros texana Chihuahuan proper

EPHEDRACEAE: 4/1
Ephedra antisyphilitica Chihuahuan (+NE TX to OK)
Ephedra aspera Madrean disjunct
Ephedra torreyana SW N American
Ephedra trifurca N Madrean

EQUISETACEAE: 3/1
Equisetum arvense Holarctical
Equisetum hyemale Holarctical
Equisetum laevigatum N American

ERICACEAE: 1/1
Arbutus xalapensis Mesoam

EUPHORBIACEAE: 59/10
Acalypha monostachya Chuhuahuan
Acalypha neomexicana Sonoran
Acalypha ostryifolia American (C&N American)
Acalypha phleoides Madrean wide
Andrachne arida Tr-Pecos-Coahuila
Argythamnia humilis S Prarie
Argythamnia neomexicana N Madrean
Bernardia obovata Chuhuahuan
Chamaesyce acuta N Chuhuahuan
Chamaesyce albomarginata N Madrean
Chamaesyce angusta S TX Endemic
Chamaesyce arizonica N Madrean (Sonoran)
Chamaesyce capitellata Sonoran Subprovince
Chamaesyce chaetocalyx Apachian
Chamaesyce cinerascens Chihuahuan-Tamaulipan
Chamaesyce dioica American Trop/Subtr
Chamaesyce fendleri WC US
Chamaesyce geyeri Prairie
Chamaesyce glyptosperma N American
Chamaesyce golondrina SW Texas Endemic
Chamaesyce hyssopifolia American Trop/Subtr
Chamaesyce jejuna N Chihuahuan
Chamaesyce lata SWC US
Chamaesyce micromera N Madrean
Chamaesyce missurica Prairie
Chamaesyce nutans C&N American
Chamaesyce perennans SW Texas Endemic
Chamaesyce prostrata C&N American
Chamaesyce revoluta N Madrean
Chamaesyce serpens American
Chamaesyce serpyllifolia N American with radiations
Chamaesyce serrula Sonoran-Chihuahuan
Chamaesyce setiloba N Madrean
Chamaesyce stictospora C&N American
Chamaesyce theriaca Chihuahuan
Chamaesyce villifera Mesoam-Madrean
Croton dioicus Mexican-Chihuahuan

Croton fruticulosus Chihuahuan-Tamaulipan
Croton incanus E Madrean (Tamaulipan)
Croton lindheimerianus S Prairie
Croton monanthogynus E N American (E Prairie-Gulf Coast)
Croton pottsii Sonoran-Chihuahuan
Croton sancti-lazari Chihuahuan
Euphorbia antisyphilitica Madrean
Euphorbia bifurcata E Madrean
Euphorbia brachycera W N American
Euphorbia cyathophora N American
Euphorbia davidii N American
Euphorbia dentata N American
Euphorbia eriantha N Madrean, disjunct
Euphorbia exstipulata N Madrean
Euphorbia marginata American
Euphorbia radians Madrean
Euphorbia spathulata N American
Jatropha dioica (only TX in US) Madrean
Phyllanthus ericoides N Chihuahuan
Phyllanthus polygonoides SC N American
Tragia amblyodonta Sonoran wide
Tragia ramosa: SWC US

FABACEAE: 107/37

Acacia angustissima American Trop/Subtr
Acacia berlandieri Chihuahuan
Acacia constricta Madrean wide
Acacia farnesiana Pantropical
Acacia greggii Madrean
Acacia neovernicosa Sonoran
Acacia rigidula Chihuahuan-Tamaulipan
Acacia roemeriana Chihuahuan
Acacia schottii (Brewster & Presidio cc) N Chihuahuan
Amorpha fruticosa Presidio c. N American
Astragalus crassicarpus Prairie wide
Astragalus emoryanus S Great Basin-N Chihuahuan disjunct
Astragalus giganteus N Chihuahuan
Astragalus humistratus S Great Basin-N Sonora-Chihuahuan
Astragalus lotiflorus Prairie
Astragalus missouriensi S Rocky M-Prairie
Astragalus mollissimus WC N American
Astragalus nuttallianus WC N American
Astragalus nuttallianus var. *austrinus* SWC N American
Astragalus wrightii S TX Endemic
Brongniartia minutifolia Tr-Pecos Endemic
Calliandra conferta Madrean (S, C&E)
Calliandra humilis Sonoran
Calliandra iselyi Tr-Pecos Endemic
Cercis canadensis E N American
Chamaecrista nictitans American
Cologania angustifolia Madrean
Cologania pallida Amphitropical ?
Crotalaria pumila American Trop/Subtr
Dalea aurea Prairie
Dalea bartonii Tr-Pecos Endemic
Dalea bicolor Sonoran
Dalea candida Prairie
Dalea enneandra Prairie
Dalea formosa SWC N American
Dalea frutescens E Madrean
Dalea greggii E Madrean
Dalea jamesii Apachian
Dalea lachnostachys N Sonoran-Chihuahuan
Dalea lanata SWC US
Dalea laniceps N Chihuahuan
Dalea leporina American, mostly Mesoam
Dalea nana Sonoran wide
Dalea neomexicana N Sonoran-Chihuahuan
Dalea neomexicana var. *longipila* S Chihuauan-Tamaulipan
Dalea pogonathera Sonoran
Dalea wrightii Sonoran-Chihuahuan
Desmanthus cooleyi Apachian
Desmanthus glandulosus N Sonoran-Chihuahuan
Desmanthus illinoensis Prairie
Desmanthus obtusus N Chihuahuan
Desmanthus velutinus N Chihuahuan
Desmanthus virgatus American (except N)
Desmodium grahamii Madrean
Desmodium neomexicanum Mesoam-Madrean (Amphitropical)
Desmodium psilophyllum Mesoam-E Madrean
Eysenhardtia spinosa Presidio c. Chihuahuan ?
Eysenhardtia texana Chihuahuan
Galactia canescens J Davis c. Chihuahuan
Galactia wrightii Sonoran
Genistidium dumosum Chihuahuan local
Glycyrrhiza lepidota WC N American
Hoffmannseggia drepanocarpa SW US
Hoffmannseggia glauca Amphitropical
Hoffmannseggia oxycarpa Chihuahuan
Indigofera lindheimeriana Chihuahuan
Indigofera miniata Mesoam (Caribbean)
Lespedeza texana Comanchian
Leucaena retusa Chihuahuan
Lotus plebeius SW N American Mont
Lupinus concinnus N Madrean
Lupinus havardii SW TX, N Tamaulipan, MO ?
Lupinus texensis Comanchian
Macroptilium atropurpureum Mesoam
Macroptilium gibbosifolium Mesoam
Mimosa aculeaticarpa Madrean wide
Mimosa borealis SWC US
Mimosa dysocarpa Sonoran wide
Mimosa emoryana Chihuahuan-Mexican Highlands disjunct
Mimosa texana Chihuahuan ?
Mimosa turneri Chihuahuan disjunct ?
Nissolia platycalyx Chihuahuan disjunct, local
Parkinsonia aculeata Subtropical
Peteria scoparia Apachian ?
Phaseolus filiformis Sonoran Subprovince
Pomaria jamesii SWC US wide
Pomaria melanosticta Tr-Pecos-Coahuila
Prosopis glandulosa W N American (mostly S)
Prosopis pubescens N Madrean
Psoralidium tenuiflorum Prairie-SWC US
Rhynchosia senna Amphitropical
Senna alata Trop/Subtr

Senna bauhinioides Madrean
Senna durangensis Chihuahuan-Tamaulipan disjunct local ?
Senna lindheimeriana Chihuahuan-Tamaulipan
Senna orcuttii Sonoran-Chihuahuan local
Senna pilosior Chihuahuan
Senna pumilio (S Prairie-Chihuahuan) SC N American
Senna roemeriana (NM & W TX) SWC US
Senna ripleyana Brewster c. ?
Senna wislizeni N & E Madrean (disjunct)
Sesbania herbacea Mesoam
Sophora nuttalliana WC N America
Sophora secundiflora E Madrean
Tephrosia vicioides Mesoam
Vicia americana N American (mostly W & N)
Vicia ludoviciana N American (S)

FAGACEAE: 20/1
Quercus arizonica Sonoran-Chihuahuan
Quercus carmenensis Chihuahuan local
Quercus depressipes J Davis c. Chihuahuan local
Quercus emoryi Sonoran-Chihuahuan
Quercus gambelii W N American
Quercus graciliformis Brewster c. Endemic
Quercus gravesii Chihuahuan
Quercus grisea Sonoran wide
Quercus hinckleyi Presidio Endemic
Quercus hypoleucoides Sonoran-Chihuahuan
Quercus intricata Chihuahuan
Quercus laceyi E Madrean
Quercus mohriana SWC US
Quercus muehlenbergii E N American
Quercus oblongifolia W Madrean
Quercus pungens Madrean (E)
Quercus robusta Brewster c. Endemic
Quercus rugosa Mesoam-Madrean
Quercus tardifolia Brewster c. Endemic
Quercus turbinella SW N American
Quercus vaseyana Chihuahuan

FOUQUIERIACEAE: 1/1
Fouquieria splendens Sonoran-Chihuahuan (N&W Madrean)

FUMARIACEAE: 2/1
Corydalis aurea Prairie N American (WC)
Corydalis curvisiliqua Prairie N American (C-SW)

GARRYACEAE: 2/1
Garrya ovata S&E Madrean
Garrya wrightii Sonoran

GENTIANACEAE: 6/3
Centaurium arizonicum N Madrean
Centaurium beyrichii Comanchian (SC US ?)
Centaurium calycosum E Madrean
Centaurium glanduliferum Tr-Pecos Endemic
Eustoma exaltatum Mesoam-N American
Gentiana affinis W N American

GERANIACEAE: 3/2
Erodium texanum SWC US ?
Geranium caespitosum W N American
Geranium carolinianum J Davis c. American

GROSSULARIACEAE: 3/1
Ribes aureum N American (not E & SE)
Ribes leptanthum J Davis c. SW N American (US)
Ribes mescalerium SWC US (SW TX-SC NM)

HYDRANGEACEAE: 8/2
Fendlera rigida Tr-Pecos-Coahuila
Fendlera rupicola Apachian
Fendlera wrightii ?
Fendlerella utahensis SW US
Philadelphus crinitus J Davis c. Endemic ?
Philadelphus mearnsii Amphitropical ? (SW US)
Philadelphus microphyllus SW US wide
Philadelphus serpyllifolius SW US disjunct

HYDROPHYLLACEAE: 15/2
Nama dichotomum W American
Nama havardii N Chihuahuan
Nama hispidum SWC N American
Nama parvifolium Chihuahuan-Tamaulipan
Nama torynophyllum Chihuahuan
Nama undulatum Chihuahuan-Tamaulipan
Phacelia caerulea Sonoran Subprovince
Phacelia congesta SC N American
Phacelia crenulata SW US
Phacelia infundibuliformis Tr-Pecos
Phacelia integrifolia SWC US
Phacelia pallida Tr-Pecos, rare
Phacelia popei SWC US
Phacelia robusta Tr-Pecos-Coahuila
Phacelia rupestris N Sonoran-Chihuahuan

IRIDACEAE: 2/1
Sisyrinchium (demissum) ?
Sisyrinchium cernuum J Davis c. W Madrean

JUGLANDACEAE: 3/2
Carya illinoinensis J Davis c. E N American
Juglans major Madrean wide
Juglans microcarpa SC N American

JUNCACEAE: 8/1
Juncus acuminatus N American-C American
Juncus arcticus J Davis c. Polichorous (Arcto-Mont)
Juncus bufonius Polichorous
Juncus ensifolius W N American
Juncus interior Prairie wide
Juncus marginatus J Davis c. American
Juncus nodosus N American
Juncus torreyi N American

KRAMERIACEAE: 3/1
Krameria erecta Sonoran (mostly W)
Krameria grayi Sonoran
Krameria lanceolata SC N American (+ Florida)

LAMIACEAE: 38/11
Agastache micrantha Chihuahuan (mostly W)
Agastache pallidiflora Sonoran
Hedeoma costata E Madrean-Caribbean
Hedeoma drummondii WC N American
Hedeoma mollis Tr-Pecos Endemic

Hedeoma nana N Madrean
Hedeoma pilosa (Extinct)
Hedeoma plicata N Chihuahuan
Hedeoma reverchonii Comanchian (TX, S OK)
Hedeoma reverchonii var. *serpyllifolia* ? S TX
Mentha arvensis Holarctical
Monarda citriodora Prairie-SWC US
Monarda fistulosa J Davis c. N American
Monarda pectinata WC US
Physostegia virginiana J Davis c. E N American
Poliomintha glabrescens Chihuahuan
Salazaria mexicana N Madrean (mostly Mohavean)
Salvia arizonica Sonoran -Chihuahuan disjunct
Salvia azurea EC US
Salvia farinacea SC US (S Prairie)
Salvia greggii Chihuahuan-Tamaulipan
Salvia henryi Sonoran- Chihuahuan (W)
Salvia lycioides Chihuahuan
Salvia reflexa N American (mostly Prairie)
Salvia regla Madrean
Salvia roemeriana Chihuahuan proper
Salvia texana Pecos c. SC N American
Salvia tiliifolia Mesoam-S American (NW)
Salvia whitehousei N Chihuahuan
Scutellaria drummondii SC-SE N American
Scutellaria potosina Sonoran-Chihuahuan
Scutellaria texana Chihuahuan
Scutellaria wrightii SC N American (TX-OK)
Stachys bigelovii Chihuahuan
Teucrium canadense J Davis c. N American-Mesoam
Teucrium coahuilanum Tr-Pecos-Coahuila
Teucrium cubense Mesoam-Madrean
Teucrium laciniatum SWC US

LEMNACEAE: 3/2
Lemna minuta J Davis c. American
Lemna valdiviana American
Spirodela polyrrhiza J Davis c. American

LILIACEAE: 16/8
Allium cernuum N American
Allium glandulosum Sonoran-Mexican Highlands
Allium kunthii Madrean
Allium coryi SW TX Endemic
Allium drummondii SC US (Prairie)
Allium perdulce Prairie
Cooperia drummondii Pecos c. SC US (+NE Mexico)
Dasylirion leiophyllum Chihuahuan
Dasylirion texanum Chihuahuan-Tmaulipan
Echeandia flavescens J Davis c. Sonoran (W)
Maianthemum racemosum J Davis c. N American Mont
Nolina erumpens Chihuahuan
Nolina texana SWC US
Nothoscordum bivalve E N American-Mesoam
Schoenocaulon texanum Chihuahuan
Zephyranthes longifolia N Sonoran-Chihuahuan

LINACEAE: 8/1
Linum aristatum SW N American
Linum berlandieri Prairie (SC)
Linum hudsonioides S Prairie
Linum lewisii W N American
Linum puberulum W N American
Linum rupestre Madrean wide
Linum schiedeanum E Madrean-Mesoam
Linum vernale Chihuahuan

LOASACEAE: 11/3
Cevallia sinuata Sonoran wide
Eucnide bartonioides Chihuahuan-Tamaulipan
Mentzelia albescens Amphitropical
Mentzelia asperula N Sonoran disjunct
Mentzelia lindheimeri Chihuahuan-Tamaulipan
Mentzelia mexicana Chihuahuan
Mentzelia multiflora Madrean (N)-S Rocky M
Mentzelia oligosperma Prairie
Mentzelia pachyrhiza Chihuahuan
Mentzelia reverchonii SC US
Mentzelia saxicola Presidio c. Chihuahuan

LYTHRACEAE: 2/2
Lythrum californicum W N American
Nesaea longipes N Chihuahun

MALPIGHIACEAE: 1/1
Janusia gracilis Sonoran (+W Chihuahuan)

MALVACEAE: 24/12
Abutilon fruticosum Tropical
Abutilon malacum Sonoran
Abutilon parvulum Sonoran
Abutilon wrightii Chihuahuan
Allowissadula holosericea Chihuahuan-Tamaulipan
Batesimalva violacea Chihuahuan-Tamaulipan
Callirhoe involucrata Prairie
Herissantia crispa Trop/Subtr
Hibiscus coulteri Sonoran wide
Hibiscus denudatus S California-Sonoran
Malvella lepidota Sonoran
Malvella leprosa Amphitropical ?
Malvella sagittifolia Sonoran
Meximalva filipes Tamaulipan
Modiola caroliniana American Trop/Subtr
Rhynchosida physocalyx S American
Sida longipes Chihuahuan-Tamaulipan
Sida neomexicana Sonoran-Chihuahuan ?
Sphaeralcea angustifolia Madrean
Sphaeralcea coccinea W N American
Sphaeralcea digitata S Great Basin-Chihuahuan
Sphaeralcea hastulata S Great Basin-S Rocky M-Sonoran wide
Sphaeralcea incana S Great Basin-S Rocky M-Chihuahuan
Sphaeralcea leptophylla S Great Basin-S Rocky M-N Chihuahuan

MARSILEACEAE: 2/1
Marsilea mollis Mesoam-S American
Marsilea vestita N American (+ Peru)

MENISPERMACEAE: 1/1
Cocculus carolinus E N American

MOLLUGINACEAE: 1/1
Mollugo verticillata American (Trop/Subtr)

MORACEAE: 2/1
Morus microphylla S Great Basin-Sonoran-N Chihuahuan

NAJADACEAE: 1/1
Najas guadalupensis American

NYCTAGINACEAE: 32/11
Abronia angustifolia S Great Basin-Sonoran
Acleisanthes acutifolia Chihuahuan
Acleisanthes longiflora Sonoran wide
Acleisanthes wrightii SW TX Endemic
Allionia choisyi Amphitropical ?
Allionia incarnata American (SW N, C, S)
Ammocodon chenopodioides Sonoran
Anulocaulis eriosolenus Chihuahuan
Anulocaulis leiosolenus SW N American
Anulocaulis reflexus N Chihuahuan local
Boerhavia anisophylla Madrean
Boerhavia coccinea Trop/Subtr
Boerhavia erecta American Trop/Subtr
Boerhavia gracillima Sonoran wide
Boerhavia intermedia Sonoran wide (N&W Madrean)
Boerhavia linearifolia Chihuahuan (+N NM)
Boerhavia torreyana Apachian
Boerhavia spicata Sonoran (W)
Boerhavia wrightii N Madrean
Commicarpus scandens American Trop/Subtr
Cyphomeris crassifolia E Chihuahuan
Cyphomeris gypsophiloides Chihuahuan wide
Mirabilis albida N American (Prairie-SW N American)
Mirabilis linearis W N American (+Prairie)
Mirabilis longiflora Sonoran wide
Mirabilis multiflora SW N American
Mirabilis oxybaphoides SW N American
Mirabilis texensis SW TX
Nyctaginia capitata Chihuahuan
Selinocarpus angustifolius Chihuahuan
Selinocarpus diffusus Pecos c. SWC US (W TX-NM)
Selinocarpus parvifolius Tr-Pecos Endemic

OLEACEAE: 8/3
Forestiera angustifolia Chihuahuan-Tamaulipan
Fraxinus cuspidata N & E Madrean Mont
Fraxinus greggii E Madrean Mont
Fraxinus papillosa N Sonoran-Chihuahuan
Fraxinus velutina N&W Madrean Mont
Menodora heterophylla N Chihuahuan (S TX)
Menodora longiflora N Chihuahuan (S TX)
Menodora scabra Madrean (no Mexican Highlands)

ONAGRACEAE: 28/4
Camissonia chamaenerioides N Madrean
Epilobium ciliatum W American
Ludwigia palustris Polichorous
Ludwigia peploides American (Polichorous)
Ludwigia repens E N American (with radiations)
Oenothera arida Chihuahuan
Oenothera albicaulis WC US
Oenothera boquillensis Chihuahuan
Oenothera brachycarpa Madrean (no Mexican Highlands)
Oenothera calcicola E Madrean
Oenothera coccinea N American-Mesoam
Oenothera elata subsp. *hirsutissima* W N American
Oenothera engelmannii SWC US ? (E NM-W TX)
Oenothera grandis Prairie
Oenothera hartwegii SWC US
Oenothera havardii Chihuahuan
Oenothera hexandra Mesoam-Madrean
Oenothera kunthiana Mesoam-Madrean
Oenothera lavandulifolius W N American
Oenothera macrocarpa Tr-Pecos
Oenothera pallida W US (not Pacific)
Oenothera primiveris N Madrean
Oenothera rosea Trop/Subtr (mostly American)
Oenothera speciosa N American-Mesoam
Oenothera suffulta subsp. *nealleyi* N Chihuahuan
Oenothera texensis Chihuahuan
Oenothera triloba Prairie
Oenothera tubicula N Chihuahuan

ORCHIDACEAE: 9/4
Dichromanthus cinnabarinus E Madrean
Epipactis gigantea W N American
Hexalectris grandiflora J Davis c. Madrean disjunct
Hexalectris nitida SE NM-S TX rare
Hexalectris revoluta ? (S AZ-SE NM-S TX)
Hexalectris spicata E N American (also S N America)
Hexalectris warnockii ? (S AZ-SW-SC TX)
? *Malaxis erhenbergii* Chisos, Brewster c. Endemic
Malaxis soulei J Davis c. American Trop/Subtr

OROBANCHACEAE: 4/2
Conopholis alpina Madrean-Mesoam (C American)
Orobanche ludoviciana N American (US)
Orobanche multicaulis Mexican Highlands-Chihuahuan ?
Orobanche uniflora J Davis c. N American

OXALIDACEAE: 3/1
Oxalis albicans Madrean wide
Oxalis dillenii N American
Oxalis drummondii Sonoran-Chihuahuan

PAPAVERACEAE: 4/1
Argemone aenea J Davis N Chihuahuan-Tamaulipan
Argemone chisosensis Chihuahuan
Argemone polyanthemos J Davis c. Prairie
Argemone sanguinea E Chihuahuan-Tamaulipan
Argemone squarrosa SWC US

PASSIFLORACEAE: 1/1
Passiflora tenuiloba Tamaulipan-N Chihuahuan

PEDALIACEAE: 4/1
Proboscidea althaeifolia Sonoran
Proboscidea louisianica N American (mostly S US)
Proboscidea parviflora N Madrean
Proboscidea spicata N Chihuahuan (local)

PHYTOLACCACEAE: 2/2
Phytolacca americana N American (mostly E)
Rivina humilis American Trop/Subtr

PINACEAE: 5/2
Pinus cembroides Madrean wide

Pinus ponderosa W N American
Pinus remota Trans-Pecos-Coahuila
Pinus strobiformis J Davis c. Apachian (AZ, NM)
Pseudotsuga menziesii W N American

PLANTAGINACEAE: 7/1
Plantago helleri SC US
Plantago hookeriana SC US (TX + Coahuila)
Plantago ovata S Palearctical/Paleotropical
Plantago rhodosperma Prairie (adventive in SW)
Plantago major Polichorous
Plantago patagonica American
Plantago wrightiana S N American

PLUMBAGINACEAE: 2/2
Limonium limbatum Pecos c. SWC US (Apachian-N Chihuahuan)
Plumbago scandens Trop American

POACEAE: 202/63
Achnatherum aridum N Madrean
Achnatherum curvifolium N Chihuahuan
Achnatherum eminens CS Madrean (proper)
Achnatherum lobatum N Chihuahuan
Agrostis exarata W N American
Agrostis hyemalis N American
Agrostis stolonifera Holarctical (Boreal)
Allolepis texana Tr-Pecos-Coahuila
Andropogon gerardii N American
Andropogon glomeratus Mesoam wide
Aristida adscensionis Polichorous (Trop/Subtr)
Aristida arizonica N Madrean
Aristida desmantha SC US (E TX & Tr-Pecos)
Aristida divaricata Mesoam-Madrean
Aristida havardii Madrean proper
Aristida pansa Madrean proper
Aristida purpurea N American (W-C)
Aristida purpurea var. *nealleyi* SW N American
Aristida purpurea var. *wrightii* SW N American
Aristida schiedeana Mesoam-N S American
Aristida ternipes Mesoam-Madrean-N S American
Blepharidachne bigelovii Tr-Pecos-Coahuila
Blepharoneuron tricholepis S Rocky M-Madrean
Bothriochloa alta Mesoam-Amphitropical Mont
Bothriochloa barbinodis American Trop/Subtr
Bothriochloa laguroides American (subtr)
Bothriochloa springfieldii American (subtr)
Bouteloua aristidoides American (subtr)
Bouteloua barbata American (subtr)
Bouteloua breviseta Chihuahuan
Bouteloua chondrosioides Mesoam-Madrean
Bouteloua curtipendula American
Bouteloua dactyloides Prairie wide (+ Mexico)
Bouteloua eriopoda SWC US (N Madrean)
Bouteloua gracilis WC N American
Bouteloua hirsuta Prairie-N Madrean
Bouteloua kayi Brewster c. Endemic
Bouteloua ramosa N Chihuahuan
Bouteloua simplex J Davis c. American (Warm-Trop/Subtr)
Bouteloua trifida N Madrean
Bouteloua uniflora Chihuahuan
Bouteloua warnockii N Chihuahuan
Bromus anomalus Mesoam-Madrean
Bromus arizonicus J Davis c. California-Sonoran
Bromus ciliatus Holarctical
Bromus lanatipes SW US (Colorado-Apachian)
Bromus marginatus W N American
Bromus polyanthus W N American Mont
Bromus rubens Pecos c. W N American
?*Cathestecum erectum* S AZ-Tr-Pecos-Guatemala ?
Cenchrus longispinus N American
Cenchrus myosuroides AmericanTrop/Subtr
Cenchrus spinifex ?
Chloris cucullata SC N American
Chloris submutica CS Madrean
Chloris texensis SW & SE TX Endemic
Chloris verticillata Prairie (+WN American)
Chloris virgata American-African (Trop/Subtr)
Cottea pappophoroides American (Amphitropical)
Dasyochloa pulchella Madrean wide
Dichanthelium acuminatum N American-Mesoam
Dichanthelium oligosanthes N American
Digitaria californica Amphitropical
Digitaria ciliaris Polichorous (Warm-Trop/Subtr)
Digitaria cognata E N American
Digitaria hitchcockii S TX- Coahuila
Digitaria patens SW-SC TX Endemic
Digitaria pubiflora SWC US-Chihuahuan (+Tamaulipan)
Digitaria sanguinalis Warm/Subtr
Distichlis spicata American
Echinochloa colona Trop/Subtr/Warm
Echinochloa crus-galli Subtr/Warm
Echinochloa crus-pavonis Presidio c. Trop/Subtr/Warm (American-African)
Echinochloa muricata N American
Elionurus barbiculmis Sonoran-Mexican Highlands
Elionurus tripsacoides American Trop/Subtr
Elymus arizonicus Sonoran-Chihuahuan
Elymus canadensis N American
Elymus elymoides W N American
Elymus trachycaulus N American (W&N)
Enneapogon desvauxii Warm/Subtr
Eragrostis barrelieri Warm Temp/Subtr (+ Trop Africa)
Eragrostis cilianensis Polichorous
Eragrostis curtipedicellata SC US
Eragrostis erosa J Davis, Presidio cc. N Chihuahuan
Eragrostis intermedia SW-SC US-Madrean
Eragrostis lehmanniana Sonoran wide
Eragrostis lugens American Trop/Subtr
Eragrostis mexicana W American
Eragrostis palmeri Chihuahuan wide
Eragrostis pectinacea American
Eriochloa acuminata ?
Erioneuron avenaceum Amphitropical
Erioneuron nealleyi Chihuahuan
Erioneuron pilosum WC N American
Festuca arizonica SW US
Festuca ligulata Chihuahuan
Festuca rubra Holarctical

Hesperostipa neomexicana SW US
Heteropogon contortus Trop/Subtr
Hilaria belangeri Chihuahuan wide
Hilaria swallenii N Chihuahuan
Hordeum jubatum Holarctical
Hordeum pusillum N American
Imperata brevifolia N&W Madrean
Koeleria macrantha Holarctical
Leersia oryzoides Holarctical
Leptochloa dubia American Warm/Subtr
Leptochloa fusca Polichorous
Leptochloa panicea Trop/Subtr (America-Asia)
Lycurus phleoides American Trop/Subtr
Lycurus setosus Amphitropical
Melica montezumae Chihuahuan
Melica nitens Appalachian (E N American)
Melica porteri SW US (Colorado-Apachian)
Microchloa kunthii Trop/Subtr (American-African)
Monroa squarrosa WC US
Muhlenbergia arenacea N Sonoran-Chihuahuan
Muhlenbergia arenicola SWC US-Chihuahuan
Muhlenbergia asperifolia W American (N Temp)
Muhlenbergia brevis SWC US-Chihuahuan
Muhlenbergia depauperata W Madrean Mont
Muhlenbergia dubia Madrean Mont
Muhlenbergia eludens Sonoran-Chihuahuam Mont
Muhlenbergia emersleyi Madrean wide
Muhlenbergia fragilis Madrean Mont (mostly W)
Muhlenbergia glauca Madrean
Muhlenbergia minutissima W N American
Muhlenbergia montana W N American
Muhlenbergia pauciflora SW US-W Madrean Mont
Muhlenbergia polycaulis W Madrean Mont
Muhlenbergia porteri N&WC Madrean
Muhlenbergia repens Madrean
Muhlenbergia rigens NC Madrean
Muhlenbergia rigida W American Mont
Muhlenbergia schreberi E N American (+S America)
Muhlenbergia setifolia Chihuahuan
Muhlenbergia spiciformis ? Caribbean
Muhlenbergia tenuifolia Madrean
Muhlenbergia texana W Madrean
Muhlenbergia torreyi SW US
Muhlenbergia villiflora Chihuahuan Mont
Nassella leucotricha S Prairie-E&S Madrean
Nassella tenuissima Amphitropical (E Madrean)
Panicum bulbosum American
Panicum capillare N American (+Temp S America)
Panicum hallii SWC US
Panicum hirticaule American (Warm/Trop/Subtr)
Panicum obtusum SWC N America
Panicum virgatum N American wide
Pappophorum bicolor Chihuahuan-Mexican Highlands
Pappophorum vaginatum Amphitropical
Pascopyrum smithii W US
Paspalum distichum Warm Temperate/Trop/Subtr
Paspalum pubiflorum E N American-Mesoam
Phalaris angusta American (coastal)
Phalaris caroliniana N American (coastal)
Phragmites australis Polichorous (warm)
Piptochaetium fimbriatum Madrean wide
Piptochaetium pringlei J Davis c. W Sonoran
Pleuraphis jamesii Presidio c. SW US
Pleuraphis mutica Sonoran wide
Poa arachnifera S Prairie
Poa bigelovii N Madrean (SWC US)
Poa fendleriana W N American
Poa strictiramea Brewster c Endemic Mont
Polypogon elongatus American Trop/Subtr
Polypogon interruptus American (W American)
Pseudoroegneria spicata W N American
Schedonnardus paniculatus Prairie
Schizachyrium cirratum Madrean (+N S America)
Schizachyrium sanguineum Trop/Subtr/Warm
Schizachyrium scoparium N American
Schizachyrium spadiceum Tr-Pecos-Coahuila
Scleropogon brevifolius Madrean-Mesoam
Setaria grisebachii Madrean-Mesoam
Setaria leucopila SWC US-E Madrean
Setaria parviflora Trop/Subtr-Warm Temperate
Setaria reverchonii SC US
Setaria scheelei Chihuahuan-Tamaulipan
Setaria villosissima Chihuahuan very local
Sorghastrum nutans American
Sphenopholis intermedia N American
Sphenopholis obtusata N American
Sporobolus airoides W N American (US)
Sporobolus contractus J Davis & Presicdio cc. SW US
Sporobolus cryptandrus N American
Sporobolus flexuosus SW US
Sporobolus pyramidatus American
Sporobolus texanus SWC US
Sporobolus wrightii Madrean wide
Tragus berteronianus Trop/Subtr
Trichloris crinita Amphitropical
Tridens albescens S Prairie (SC US)
Tridens eragrostoides Gulf Coast-Tamaulipan-N Chihuahuan
Tridens muticus SWC US-Chihuahuan
Tripsacum dactyloides E N American-Mesoam-NW S American
Trisetum interruptum SWC US (S Prairie-Gulf Coast ?)
Urochloa arizonica Sonoran wide-Mexican Highlands
Urochloa fusca American Trop/Subtr
Vulpia octoflora N American

POLEMONIACEAE: 10/4
Gilia stewartii Chihuahuan wide
Giliastrum acerosum SWC US
Giliastrum incisum Chihuahuan wide
Giliastrum insigne Tr-Pecos-Coahuila
Ipomopsis aggregata W N American
Ipomopsis havardii Tr-Pecos-Coahuila
Ipomopsis laxiflora SWC US
Ipomopsis longiflora SWC US-E Prairie
Ipomopsis pumila WC US
Phlox nana Apachian

POLYGALACEAE: 9/1
Polygala alba Prairie-Madrean wide
Polygala barbeyana Madrean wide
Polygala hemipterocarpa J Davis c. Sonoran-Chihuahuan
Polygala lindheimeri Sonoran-Chihuahuan
Polygala macradenia Sonoran wide-Mexican Highlands
Polygala maravillasensis Chihuahuan local
Polygala nudata Chihuahuan
Polygala obscura J Davis c. N Sonoran-Chihuahuan
Polygala scoparioides Sonoran-Chihuahuan wide

POLYGONACEAE: 20/3
Eriogonum abertianum (S Great Basin)-Sonoran-Chihuahuan
Eriogonum alatum WC US
Eriogonum annuum Prairie
Eriogonum havardii N Chihuahuan
Eriogonum hemipterum Tr-Pecos-Coahuila
Eriogonum hieraciifolium S Great Basin-Chihuahuan low Mount
Eriogonum jamesii SWC US
Eriogonum longifolium Pecos c SC US
Eriogonum nealleyi Pecos c. S TX Endemic
Eriogonum polycladon J Davis c. S Great Basin-Sonoran
Eriogonum rotundifolium Chihuahuan
Eriogonum suffruticosum Tans Pecos Endemic
Eriogonum tenellum Colorado, E New Mexico, W OK, N, W, C& SW TX ?
Eriogonum wrightii N Madrean
Polygonum longistylum var. *omissum* ?
Polygonum punctatum American
Polygonum pensylvanicum N American-Mesoam
Polygonum glabrum Atlantic-Gulf Coast-Caribbean (+Madagascar&China)
Polygonum hydropiperoides American
Rumex maritimus N &W N American

POLYPODIACEAE: 1/1
Pleopeltis riograndensis N Sonoran-Chihuahuan

PONTEDERIACEAE: 3/1
Heteranthera dubia N American
Heteranthera reniformis Mesoam-S American
Heteranthera rotundifolia Mesoam-S American

PORTULACACEAE: 9/4
Phemeranthus aurantiacus Apacian-E Madrean
Phemeranthus brevicaulis N Chihuahuan+ NE NM
Phemeranthus longipes ? (Apachian)-Chihuahuan-Tamaulipan
Phemeranthus parviflorus Prairie
Portulaca pilosa Trop/Subtr
Portulaca suffrutescens Sonoran
Portulaca umbraticola American Trop/Subtr
Talinopsis frutescens Chihuahuan
Talinum paniculatum American

POTAMOGETONACEAE: 2/1
Potamogeton foliosus Presidio c. N American
Potamogeton nodosus Polichorous

PRIMULACEAE: 3/2
Androsace occidentalis N American
Androsace septentrionalis Holarctical
Samolus ebracteatus Mesoam-Madrean

PTERIDACEAE: 33/8
Adiantum capillus-veneris Trop/Subtr/Warm
Argyrochosma limitanea Madrean wide
Argyrochosma microphylla Sonoran wide
Astrolepis cochisensis Madrean wide
Astrolepis integerrima Madrean wide
Astrolepis sinuata American Trop/Subtr/Warm
Astrolepis windhamii Sonoran
Bommeria hispida Sonoran
Cheilanthes alabamensis Appalachian-N Madrean
Cheilanthes bonariensis American-African
Cheilanthes eatonii Madrean wide
Cheilanthes feei N American
Cheilanthes horridula E Madrean
Cheilanthes kaulfussii Mesoam-Central American
Cheilanthes lendigera Mesoam-Central American
Cheilanthes lindheimeri Madrean
Cheilanthes tomentosa S& SE N American
Cheilanthes villosa Sonoran-Chihuahuan
Cheilanthes wrightii Sonoran
Notholaena aliena Chihuahuan ?
Notholaena aschenborniana E Madrean
Notholaena copelandii E Madrean
Notholaena grayi Sonoran-Chihuahuan
Notholaena greggii Chihuahuan
Notholaena nealleyi E Madrean ?
Notholaena neglecta Chihuahuan
Notholaena standleyi E Madrean-Apachian
Pellaea atropurpurea N American-Mesoam
Pellaea intermedia Sonoran-Chihuahuan
Pellaea ovata Mesoam-S American
Pellaea ternifolia Mesoam-S American
Pellaea truncata J Davis c. N Madrean
Pellaea wrightiana ? (N American, sporadic)

RAFFLESIACAE: 1/1
Pilostyles thurberi SW N American disjunct

RANUNCULACEAE: 11/7
Anemone berlandieri SC-SE US
Anemone tuberosa N Madrean
Aquilegia chrysantha Apachian-N Sonoran SW US
Aquilegia longissima N Sonoran ? N Chihuahuan ?
Clematis drummondii Sonoran wide
Clematis pitcheri Illinoan-TX. EN American (wide)
Delphinium wootonii Apachian
Delphinium madrense Chihuahuan-Tamaulipan
Myosurus minimus Holarctical
Ranunculus sceleratus Holarctical
Thalictrum fendleri Presidio, J Davis W N American

RESEDACEAE: 1/1
Oligomeris linifolia Madro (N Madro)-Tethyan ?

RHAMNACEAE: 11/9
Adolphia infesta C-S Madrean (Mexican Highlands-Sonoran)
Ceanothus greggii Madrean Mont
Colubrina texensis Chihuahuan

Condalia ericoides Sonoran Mont
Condalia viridis Chihuahuan (+Sonora)
Condalia warnockii Sonoran
Frangula betulifolia Madrean wide Mont
Karwinskia humboldtiana Caribbean-Sonoran
Rhamnus serrata C-S Madrean Mont
Sageretia wrightii Sonoran Mont
Ziziphus obtusifolia Madrean

ROSACEAE: 12/9
Cercocarpus montanus W N American Mont
Crataegus tracyi S TX-Coahuila
Fallugia paradoxa NC Madrean
Holodiscus dumosus W N American (not coastal)
Malacomeles denticulata ? Mesoam Mont disjunct
Petrophyton caespitosum W N American
Prunus havardii Tr-Pecos Endemic Mont
Prunus murrayana Tr-Pecos Endemic Mont
Prunus serotina ? American-European
Prunus virginiana J Davis c. N American (not SE)
Purshia ericifolia Tr-Pecos-Coahuila
Vauquelinia corymbosa Chihuahuan-Tamaulipan disjunct Mont

RUBIACEAE: 17/6
Bouvardia ternifolia Mesoam Mont
Cephalanthus occidentalis N American (not Central)
Galium correllii Chihuahuan local
Galium mexicanum Mesoam
Galium microphyllum Madrean (not Cal)
Galium proliferum N Madrean
Galium uncinulatum Mesoam
Galium virgatum SC US (Comanchian)
Galium wrightii N Madrean Mont (mostly Sonoran)
Hedyotis intricata Chihuahuan
Houstonia acerosa S Rocky M-Chihuahuan Mont
Houstonia humifusa SC US
Houstonia wrightii J Davis c. NW Sonoran
Stenaria butterwickiae Tr-Pecos Endemic
Stenaria mullerae N Chihuahuan local
Stenaria nigricans E N American
Stenaria rupicola N Chihuahuan (Tr-Pecos ?)

RUTACEAE: 4/4
Choisya dumosa Sonoran
Ptelea trifoliata N American-European
Thamnosma texana N Sonoran (+Chihuahuan)
Zanthoxylum parvum Tr-Pecos Endemic Mont

SALICACEAE: 6/1
Salix amygdaloides Presidio c. N American
Salix exigua W N American
Salix gooddingii N Madrean
Salix lasiolepis W N American
Salix nigra E N American
Salix taxifolia Madrean

SAPINDACEAE: 2/2
Sapindus saponaria Trop/Subtr
Ungnadia speciosa Chihuahuan wide ? (+SCW Africa + SW China)

SAPOTACEAE: 1/1
Sideroxylon lanuginosum SC& SE US

SAURURACEAE: 1/1
Anemopsis californica W Madrean

SAXIFRAGACEAE: 1/1
Heuchera rubescens W Madrean

SCROPHULARIACEAE: 29/13
Agalinis calycina Chihuahuan local
Bacopa monnieri Trop/Subtr
Bacopa rotundifolia ? American temperate
Buchnera americana E N American
Castilleja sessiliflora Prairie
Castilleja mexicana Chihuahuan
Castilleja integra S Rocky M-W Madrean
Castilleja lanata Madrean
Castilleja rigida Chihuahuan
Epixiphium wislizeni SWC US
Leucophyllum candidum Chihuahuan
Leucophyllum frutescens Chihuahuan-Tamaulipan
Leucophyllum minus Chihuahuan
Maurandella antirrhiniflora Mesoam-Madrean
Mecardonia procumbens American Trop/Subtr
Mimulus dentilobus W Madrean
Mimulus glabratus American
Nuttallanthus texanus N American
Penstemon ambiguus SWC US
Penstemon baccharifolius Chihuahuan
Penstemon barbatus SW US-Madrean Mont
Penstemon dasyphyllus Sonoran-Chihuahuan (W)
Penstemon fendleri SWC US
Penstemon havardii Tr-Pecos-Coahuila Mont
Penstemon jamesii Apachian
Penstemon ramosus Madrean
Penstemon wrightii Tr-Pecos Endemic
Seymeria scabra Chihuahuan
Veronica peregrina Polichorous

SELAGINELLACEAE: 9/1
Selaginella arizonica Sonoran
Selaginella lepidophylla E&S Madrean Mont
Selaginella mutica Rocky M
Selaginella peruviana W American
Selaginella pilifera Tr-Pecos-Queretaro disjunct
Selaginella rupincola Mexican Highlands-Sonoran Mont
Selaginella underwoodii W N American (Rocky M)
Selaginella viridissima Tr-Pecos-Coahuila
Selaginella wrightii Chihuahuan-Tamaulipan

SIMAROUBACEAE: 1/1
Holacantha stewartii Chihuahuan

SOLANACEAE: 32/10
Calibrachoa parviflora American (SN, Mesoam)
Chamaesaracha coniodes SC N American
Chamaesaracha coronopus SW US wide-N Mexico
Chamaesaracha pallida Chihuahuan
Chamaesaracha sordida SWC N American
Chamaesaracha villosa Chihuahuan
Datura quercifolia ?

Datura wrightii N American (mostly W)
Lycium berlandieri Sonoran-Chihuahuan wide
Lycium pallidum SW US
Lycium puberulum Chihuahuan
Lycium texanum Tr-Pecos Endemic
Lycium torreyi N Madrean
Margaranthus solanaceus Madrean
Nectouxia formosa CS Madrean
Nicotiana glauca SC American
Nicotiana obtusifolia Madrean (N+W)
Nicotiana repanda Chihuahuan ?
Physalis angulata American Trop/Subtr
Physalis cinerascens SC N American-Mesoam
Physalis hederifolia Madrean-Prairie
Physalis heterophylla N American
Physalis mollis SE N American
Quincula lobata SWC N America
Solanum citrullifolium ?
Solanum davisense Tr-Pecos-Coahuila
Solanum douglasii American Trop/Subtr
Solanum elaeagnifolium American
Solanum leptosepalum Tr-Pecos-Coahuila
Solanum ptychanthum N American
Solanum tenuipes Chihuahuan
Solanum triquetrum Chihuahuan-Tamaulipan

STERCULIACEAE: 4/1
Ayenia filiformis Sonoran
Ayenia microphylla Sonoran-Chihuahuan
Ayenia pilosa Tamaulipan
Melochia pyramidata American Trop/Subtr

THELYPTERIDACEAE: 1/1
Thelypteris ovata Gulf Coast-Caribbean

TYPHACEAE: 1/1
Typha domingensis Trop/Subtr

ULMACEAE: 3/1
Celtis pallida Torr. Mesoam-S American
Celtis laevigata EN American
Celtis reticulata W N American wide (not Pacific)

URTICACEAE: 1/1
Parietaria pensylvanica N American

VERBENACEAE: 21/8
Aloysia gratissima Amphitropical
Aloysia wrightii Sonoran wide
Bouchea linifolia Chihuahuan (S TX- Coahuila)
Bouchea spathulata Chihuahuan (Tr-Pecos-Coahuila)
Glandularia bipinnatifida N American (Prairie)
Glandularia pumila SC US
Glandularia quandrangulata Chihuahuan-Tamaulipan
Lippia graveolens Mesoam-C American
Lantana achyranthifolia Mesoam-S American (subtr)
Lantana urticoides ? Madrean with radiations
Phyla cuneifolia WC US. Prairie
Phyla fruticosa American Trop/Subtr
Phyla nodiflora American Trop/Subtr
Tetraclea coulteri Sonoran wide
Verbena bracteata J Davis & Presidio cc. N American
Verbena canescens E Madrean
Verbena halei E Madrean-Gulf Coast
Verbena neomexicana Sonoran
Verbena perennis Sonoran
Verbena plicata SWC US
Verbena scabra Mesoam

VIOLACEAE: 1/1
Hybanthus verticillatus SWC US-Prairie

VISCACEAE: 6/1
Phoradendron coryae Sonoran
Phoradendron hawksworthii N Chihuahuan
Phoradendron juniperinum W N American
Phoradendron macrophyllum California-Sonoran
Phoradendron tomentosum E-S N American
Phoradendron villosum ?

VITACEAE: 2/2
Cissus trifoliata Mesoam-S N American
Vitis arizonica Madrean wide

ZANNICHELLIACEAE: 1/1
Zannichellia palustris Polichorous

ZYGOPHYLLACEAE: 8/4
Guajacum angustifolium Chihuahuan-Tamaulipan
Kallstroemia californica N & W Madrean
Kallstroemia grandiflora W Madrean
Kallstroemia hirsutissima Sonoran-Chihuahuan
Kallstroemia parviflora Madrean wide-Amphitropical (Peru)
Kallstroemia perennans SW TX Endemic
Larrea tridentata Madrean wide (W)
Peganum mexicanum Chihuahuan-S Sonora

ACKNOWLEDGMENTS

I deeply thank Michael Powell and Steven McLaughlin for review and helpful comments, S. McLaughlin, S. Manchester, and M. Lavin for the offprints of their works, and my husband A. Karabegov for the help with the wording. This work was supported by a grant from Sam Taylor Foundation. I am very thankful to all the contributors to the Tropicos and Flora Texas Consortium as well as other botanical databases for the data available online. My deepest gratitude goes to John Kartesz and Christopher Meacham for the software, *Synthesis of the North American Flora*.

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